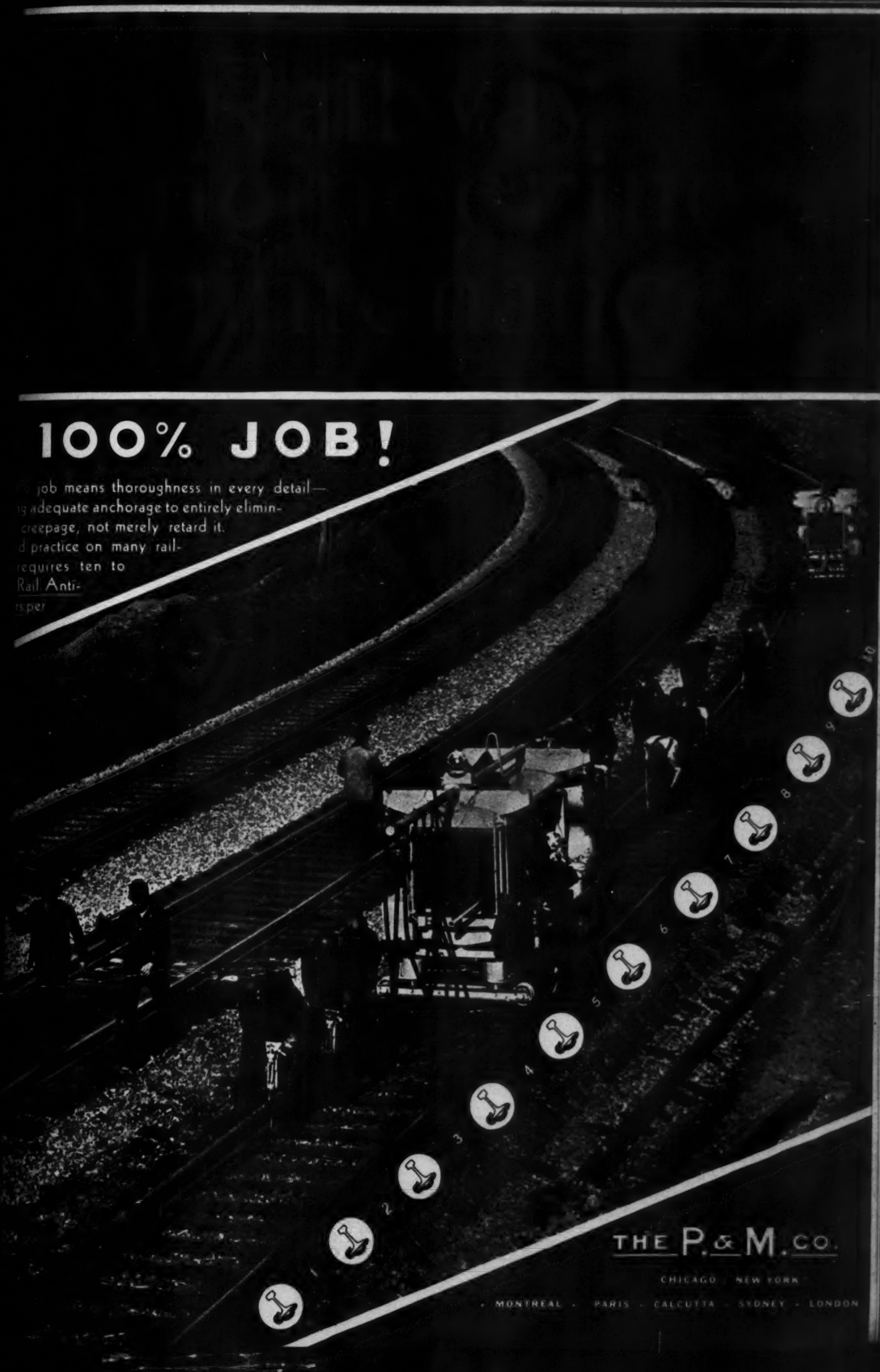

100% JOB!
job means thoroughness in every detail—
g adequate anchorage to entirely elimin-
creepage, not merely retard it.
d practice on many rail-
requires ten to
Rail Anti-
rs per
THE P. & M. CO.
CHICAGO · NEW YORK
· MONTREAL · PARIS · CALCUTTA · SYDNEY · LONDON

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, and Canada, $2.00; Foreign $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

CHECK THE *plus values*

in

BARCO TYTAMPERS

✓ PORTABLE

The BARCO Unit Tytamper "completely self-contained," is portable . . . and requires only one man to carry and operate it.

✓ LOW COST

BARCO Tytampers can be used in pairs for spot tamping or in large gangs . . . without any special accessories.

✓ NO EXPENSIVE AUXILIARY EQUIPMENT

Being self-contained units BARCO Tytampers require no heavy expensive auxiliary equipment. They have plenty of power for any tamping requirements and keep pace with heavier and more expensive equipment.

Operating at a cost of but a few cents an hour, including fuel, lubrication, and occasional renewal of a battery, spark plug and springs . . . BARCO Tytampers cut tamping costs, increase efficiency. Check into BARCO performance. Send for "Interesting Facts on Tamping."

BARCO

BARCO MANUFACTURING COMPANY
1805 W. WINNEMAC AVE., CHICAGO, ILL.

THE HOLDEN CO., LTD.
In Canada
Montreal - Moncton - Toronto - Winnipeg - Vancouver

No. 103 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Reciprocity

July 1, 1937

Dear Reader:

"Why should we advertise? Our company is a large shipper and we get our share of railway business. In fact, we don't have to do much selling." This was the remark made by a manufacturer of materials used by the railways a few days ago. It illustrates a type of selling of which much has been heard in certain quarters during the last six or seven years of subnormal activity. Is it sound? Does it represent best practice from the standpoint of either seller or buyer?

In my day-to-day contacts with those of you who are responsible for the maintenance of the tracks and structures and for the selection of the materials entering therein, I am impressed with the conscientiousness with which you are endeavoring to select those materials that will best meet your needs. I know also of the discouragement that you feel when your traffic or executive officers put pressure on you to substitute some material that you know is less efficient or desirable.

I have observed furthermore that reciprocity reduces the effectiveness of a manufacturer's sales force, for, with traffic as a weapon, a salesman soon loses the ability to present the merits of his product in a convincing manner. Reciprocity contributes, therefore, to less effective selling. For the same reason, it removes one of the strongest incentives for the improvement of a manufacturer's product —that of excelling competing materials.

And reciprocity works both ways, for the railways can demand, as the price for their business, the routing of traffic to which they are not otherwise entitled, with resulting loss in efficient service to the shipper. It should also be recalled that reciprocity never created a ton of freight or led to the purchase of any material that would not otherwise have been bought. It merely disturbs the orderly routine of business. It is injurious alike to buyer and seller, for it substitutes an element of force into negotiations which should be based on the merit of a product and its cost.

I know that I reflect your thought when I express the hope that reciprocity will disappear with the return of maximum business to manufacturer and railway alike and that sales efforts will again be based universally on the merits of a product and buying will be done with the needs of the property in mind, unswayed by other influences.

I know also that I express your appreciation of those companies which, even though able to route traffic, have studiously refrained from bringing this consideration into the picture but have at all times presented their product to you solely on its merit.

Yours sincerely,

Elmer T. Howson

Editor

ETH:EW

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

July, 1937

Published on the first day of each month by the

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
1081 National Press Bldg.

SEATTLE
1038 Henry Bldg.

SAN FRANCISCO
111 Sutter Street

LOS ANGELES
Union Bank Bldg.

Samuel O. Dunn, *Chairman of the Board;* Henry Lee, *President;* Lucius B. Sherman, *Vice-President;* Cecil R. Mills, *Vice-President;* Roy V. Wright, *Vice-President* and *Secretary;* Frederick H. Thompson, *Vice-President;* Elmer T. Howson, *Vice-President;* F. C. Koch, *Vice-President;* John T. DeMott, *Treasurer.*

Subscription price in the United States and Possessions, and Canada, 1 year $2, 2 years $3; foreign countries, 1 year $3; 2 years $5. Single copies, 35 cents each. Address H. E. McCandless, Circulation Manager, 30 Church Street, New York, N.Y.

Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.).

Railway Engineering and Maintenance

Railway Purchases

A Contribution to National Recovery

THERE is an old saying that you never miss the water until the well runs dry. This applies with equal effectiveness to railway purchases. In the hectic days of the "twenties," manufacturers and the public at large gave little thought to the volume of railway buying or to its contribution to the prosperity of that era. Yet within a period of five years the purchases of the railways, other than coal, declined from a 1925-29 average of $1,400,000,000 a year to $320,000,000 in 1932-33, a *decrease* of more than $1,000,000,000 per year, or 3-1/3 million dollars every working day. The influence of such an enforced reduction in purchasing power on unemployment directly and indirectly can be appreciated only in part. Yet it affords a measure of the contribution which the railways can make to the industrial life of the country if allowed to make adequate earnings.

Trend Now Upward

Now a different picture is being unfolded. Railway earnings are increasing and the railways are immediately returning to the markets for the materials and the equipment which they sorely need but which they have been unable to purchase until now. The extent of their return is indicated by figures just compiled by the Railway Age showing total purchases during the first five months of 1937 of $552,000,000, or eliminating fuel, of $419,000,000 from manufacturers. This latter figure is larger by $148,000,000, or 55 per cent than in the corresponding period of 1936 and $325,000,000 larger than in the first five months of 1932. Much of this outlay is going for new cars and locomotives, approximating $111,430,000; yet the purchase of materials other than equipment and fuel exceeded $300,000,000 and was larger by $85,000,000 than in 1936 and more than three times as large as in 1932.

Maintenance of Way

Turning specifically to maintenance of way expenditures, the same upward trend is apparent, although to a somewhat lessened degree. In the first four months of 1937 (the latest for which figures are available), the Class I railways of the United States spent $147,060,248 for maintenance of way. This is 10 per cent more than in the same period of 1936; it is $55,689,000, or 61 per cent, more than in the same four months of 1932. And the spread is increasing from month to month—it was 16 per cent larger in April, 1937, than in April, 1936.

Approximately 52 per cent of this expenditure, or $76,000,000, went directly for wages for some 230,000 railway employes (April figure), while $71,000,000 went to the manufacturers of materials and equipment, who in turn expended the larger part for payrolls. As compared with 1932, the railways are now spending $450,000 a day *more* for maintenance of way activities alone, providing employment directly and indirectly for more than 75,000 additional men. And these figures for maintenance of way include only those charges that accrue to operating accounts, to the exclusion of the very appreciable charges for betterments and additions that are a part of almost every maintenance operation. This is the contribution which a single branch of the railway industry (the maintenance of way department) is now making to industrial recovery.

What Is Ahead?

Yet, important as has been the progress to date, one may well look also at the distance there is yet to go. This is best measured by the fact that in the first four months of 1929, the expenditures for maintenance of way totaled $253,794,371 and in the corresponding period of 1928 only $3,600,000 less. In other words, although present expenditures are 60 per cent larger than those of 1932, they are still 40 per cent less than in the years of adequate maintenance.

In considering the marked increase in railway purchases and the less rapid increase in maintenance of way expenditures, it is to be noted that this is the normal trend as the roads emerge from a period of restricted buying. Confronted with rising business, the roads normally enter the market first for cars and locomotives, and less rapidly for those materials entering into roadway repair and improvement. As the equipment is replenished, the expenditures go more and more largely into roadway improvements to enable the roads to handle the traffic expeditiously and safely and also to reduce the cost of roadway maintenance. It is to be expected that this trend will be repeated in the months and years immediately ahead and that maintenance expenditures will not only keep pace with gross and net earnings and with purchases as a whole, but will increase at an accelerated rate.

What do such facts mean to the public at large? The relationship between railway earnings and employment should be obvious. Yet we see the public making large

expenditures for waterways and terminals to divert traffic from the railways to barges; for airports, lighted airways and special weather forecasts to promote further diversion of passengers to the airplanes; and for highway speedways for buses and trucks of all descriptions to cut still deeper into rail revenues. When these expenditures are being made for services of less dependability and safety, less universal availability and offering far less employment possibilities, it is apparent that the public at large has no true conception of the relative contributions to the public welfare of the railways and these competitive transportation agencies.

For this lack of knowledge, railway employees must accept their full share of responsibility, for the public cannot be blamed if it does not have the facts. The more than 1,100,000 railway employees now in service, who with their families, comprise more than three times that number of persons, can do much to enlighten the people at large if they will use the opportunities that come to them to present the facts to those with whom they come in contact from day to day.

The railways will stand up favorably with other agencies in any comparison of public benefactions that may be made. The problem is to disseminate the facts. No group has a more direct interest in this dissemination than railway employees. Much of this work will not and cannot be done unless they do it.

Paint Failures

May be Result of Improper Application

FAILURE of paint films always raises questions concerning the quality of the materials in the paint. Sometimes the materials are at fault, but more often the trouble can be traced to improper application or to application under conditions that do not permit a normal service life. Failure by chalking is a case in point. Under proper conditions this form of failure is the natural and desirable one. Under unfavorable conditions it may mean shortened life for the paint and unnecessary exposure of the underlying surface to deterioration.

Paint loses its gloss and chalks because the vehicle is destroyed by exposure to the elements, allowing the pigments to form a dust-like layer over the surface. When this occurs slowly as a natural process, it is the most desirable form of paint failure. In fact, a chalked surface insures the proper amount of "tooth" to give a tenacious bond with a subsequent coat when repainting. On the other hand, premature chalking usually indicates that the oil was of poor quality; that if satisfactory, a sufficient quantity was not used; or that too much drier was put in the paint. Another cause sometimes met with is the application of a film that is too thick.

No remedy for natural chalking has been discovered. Premature chalking can be avoided by eliminating the causes which have been mentioned; it cannot be stopped once it is under way. Natural chalking can be overcome by applying an additional coat that is sufficiently rich in oil to satisfy the "suction" of the old paint, without itself becoming lean. Paint possesses many peculiarities and is subject to many forms of failure. It is always well, however, to be certain that the conditions under which it was applied were favorable and that the method of application was correct, before condemning paint that has failed.

Structural Welding

How Far Have We Gone in This Field?

TEN YEARS have come and gone since fusion welding was first applied on a comprehensive scale in the strengthening of a steel railway bridge, the Chicago Great Western crossing of the Missouri river at Leavenworth, Kan. What progress has been made in the extension of welding to railway structures during this decade?

The work on the Leavenworth bridge was heralded as the dawn of a new era in steel bridge building and within a year the construction of an all-welded steel truss span for a spur track on the Boston & Maine at Chicopee Falls, Mass., was the object of widespread publicity on the part of the proponents of the new process. However, this latter project proved of greatest value in demonstrating that there was much to learn about the application of welding to the construction of steel bridges before it could supplant riveting in the fabrication and erection of new bridges, and only a few welded railway bridges have since been constructed.

The reasons are not hard to find. Railway bridge engineers are conservative; they realize that the enviable record for freedom from bridge disasters represents the result of years of development, that embraces everything from a superior knowledge of the mathematics of bridge design to better trained and more effectively organized maintenance forces. They know also that design practice today is better than it was in the past, not only because of a better knowledge of the theory of structures and the properties of materials but also because it is based on accumulated field experience with the behavior of riveted joints in all manner of details and under a great variety of conditions. Such a knowledge, they contend, cannot be reproduced overnight regarding an entirely new method of connecting steel plates and shapes.

In the meantime, however, railway bridge engineers and their field forces have applied fusion welding on an extended scale to the repair and strengthening of old bridges, the results of this work have been carefully studied, and practices revised as faulty results

indicated the need for changes. Furthermore, railway engineers have co-operated with others who are vitally interested in this process in endeavoring to find the answers to some of the perplexing problems involved —for example, the question of locked-up stresses resulting from the heating of the base metal, and the strength of welds—especially the fatigue strength to resist stress reversals. In carrying on this work they participated in the drafting of the first comprehensive specifications of structural welding, and under the auspices of the American Railway Engineering Association they have drafted a set of specific recommendations covering work in this field. This treatise should prove of such value both in the office and the field that is is presented in abstract on page 474 of this issue.

Thus it is seen that, while progress has been slow, it has been conducted in an orderly fashion that has been fruitful of results which should lead to a steady increase in the application of the fusion welding process in railway bridges.

Adzed Ties

Protecting Exposed Surfaces Against Decay

MUCH has been written and more has been said orally about the protection of cut surfaces of treated timber. The adzing of ties when laying rail, as done on many roads, presents an excellent example of wholesale cutting through the zone of heavy treatment on the outside of the timber and of the exposure of untreated or only partially treated wood beneath this outer shell.

As rail is laid today, the gang engaged in the work advances rapidly, and every unit comprising it must advance at the same uniform rate or confusion will result, the work will be delayed and the unit cost will rise rapidly. Because of the necessity for this rapid progress and to avoid the possibility of interference with other units of the gang, some roads make no effort to apply a protective coating to the newly-adzed surfaces of the ties. Others, recognizing the importance of measures that will prevent or at least retard the decay that might otherwise gain a foothold on the untreated surfaces but which doubt the practicability of heating the preservative to be used as a protective coating, are either applying cold creosote to the adzed surfaces or are using some preservative compound that is designed to be used as a cold application.

Still others believing that creosote, either alone or in mixture with petroleum, affords the best protection when applied hot that it is possible to give the ties, considering the conditions under which the work must be done, provide their gangs with equipment for heating the creosote and insist that it be applied hot to the surfaces exposed in adzing.

Ties constitute the largest single item of maintenance expense. To prolong their service life and thus reduce this cost, the railways are spending relatively large sums for preservative treatment, the whole effect of which may be lost and the expenditure wasted if the way is opened for the entrance of decay-producing organisms by adzing the ties and then failing to protect the surfaces exposed by means that are known to be effective.

The cost of this protection is relatively small, especially when compared with the losses that may accrue through shortened tie life when it is omitted. Those roads that are applying hot creosote find that they can do this without interfering in any way with the laying of the rail or delaying any of the units engaged in the work. In other words, the rail can be laid as rapidly when adequate measures are taken to protect the wood exposed in adzing, as when this protection is omitted.

Irregular Line

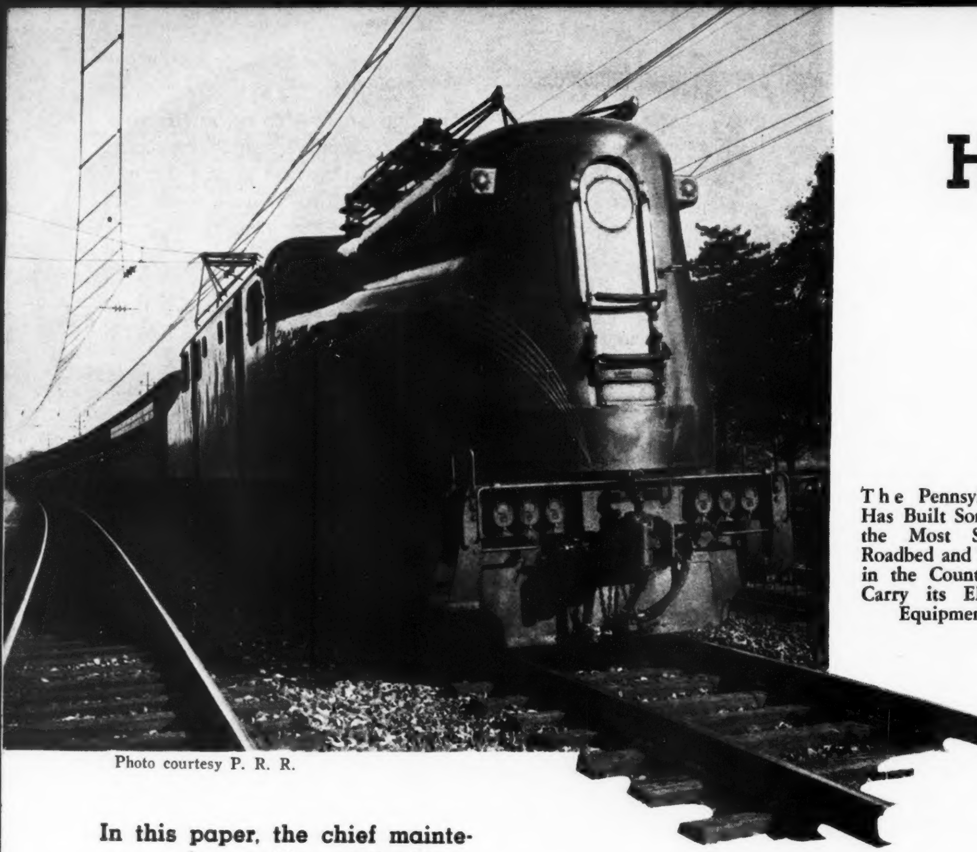
Its Effect on Riding Quality and Maintenance

GOOD line has always been considered an essential of good track. However, recent developments in high-speed passenger service have directed attention to this detail of track maintenance more intensively than ever before. Even at moderate speed, irregularities in line cause lurching movements or side swings in cars which are quite noticeable. As the speed increases these movements become more violent causing considerable discomfort to passengers. At high speed, irregular line has a greater adverse effect on the riding qualities of the track than comparable defects in surface.

Obviously, smooth-riding track cannot be secured by lining alone, since line is so intimately interrelated with surface, cross level, gage, expansion allowance, rail anchorage, tie condition, ballast, stability of the roadbed and drainage that defects in or neglect to give the needed attention to any of these have an immediate effect on line which will be apparent in the riding qualities of the track. Again, irregular line will cause irregular wear on the gage side of the head of the rail and perceptible wear on the fastenings which will progressively increase the difficulty of maintaining good line.

Experience has shown that if the track is out of line, little else can be done to make it ride smoothly. Conversely, if the other defects mentioned are not corrected good line cannot be maintained. It should be borne in mind that track does not have to be grossly out of line to produce uncomfortable riding or an adverse effect on maintenance, for at high speed even slight irregularities are apparent on tangents, and on curves these ill effects are intensified. Modern speeds are developing a new point of view in track maintenance, for they are emphasizing not only the need for greater refinement in maintenance, but particularly the interdependence of all of the elements of the track structure if the higher standards that are being demanded in increasing measure are to be attained.

High-Speed S



The Pennsylvania Has Built Some of the Most Sturdy Roadbed and Track in the Country to Carry its Electric Equipment

Photo courtesy P. R. R.

In this paper, the chief maintenance of way officer of the Pennsylvania discusses the many factors in roadway and track construction and maintenance which must be given special consideration to permit economical and comfortable high-speed operation with the greatest degree of safety. He also points out the importance of properly designed power to economical track maintenance and refers briefly to some of the studies and tests made, and measures taken on the Pennsylvania, in the interest of a stronger, more stable, and smoother-riding track structure.

THE EFFECT of increased speed upon the track structure has been a subject of study for many years. While high speeds have obtained in a number of instances in the past, they have usually been confined to special movements, or test runs, whereas today there are many regular daily runs on a number of railways where speeds are sustained at substantially higher levels than formerly. In recent years on the Pennsylvania alone there has been a total daily saving of 33 hr. 40 min. in the running time of 37 of our important passenger trains operating between the Eastern Seaboard and points in the Middle West. At the same time, the average speed of our freight trains has been quickened approximately 43 per cent, or, putting it in another way, the saving in time for an average freight shipment amounts to 7 hours.

*Presented before the Metropolitan Track Supervisors' Club, New York, on April 22.

Speed Increases Punishment

A general impression that the effect of speed varies as the square of the speed is not entirely true as regards the effect of rolling equipment on the track. There are certain oscillatory movements of the parts of the locomotive which, under the higher speeds, may synchronize with the oscillations of the locomotive as a whole on the track, resulting in the building up of very high forces between the locomotive and the track at certain critical speeds.

Flat spots on wheels and battered rail ends, or other similar defects, result in very materially increased dynamic loads on the rail. For example, a loaded coal car with 33-in. wheels, passing over a depression in the rail 4 in. long, or with a flat spot of similar length on one of the wheels, produces its maximum blow on the rail at a speed of 10½ m.p.h., while in the case of a defect in the rail having a length of 8 in., the maximum blow is produced at 21 m.p.h. It is to be noted that the speed of maximum effect varies with the length of the defect and not with its depth, while if the car is moving at the speed producing the maximum effect, the increased dynamic pressure on the rail will then vary with the depth of the defect.

The amplitude of lateral oscillations of equipment varies, of course, with the clearance between the gage of the track and the gage of the wheels, and the period of such oscillations depends upon the design of the locomotive. It has been found that the period of oscillations is generally much shorter with steam locomotives than with electric locomotives. For instance, in the case of our K-4 type (4-6-2) steam passenger locomotive, moving at a speed of 90 m.p.h. on tangent track, six complete lateral oscillations are made per second, whereas an electric locomotive in similar service has a performance of only 1.6 oscillations per second.

Tests Show Effects

The effect produced upon the track by various types of locomotives and other units of equipment is very different. The results of a large number of locomotive test runs at Claymont, Del., in which lateral thrust against the rail was measured, show that in some cases the thrust varied as the square of the speed, while in

Service Demands Higher Track Standards*

By ROBERT FARIES
Assistant Chief Engineer, Maintenance, Pennsylvania

other cases, with other types of equipment, the ratio was more nearly in direct proportion to the speed. The tendency toward critical speeds for different types of equipment was very apparent. At the higher speeds, the effects of stops and speed restrictions requiring longer decelerating and accelerating periods, increase the work that the track structure has to perform.

The shifting of weight from one rail to the other is more noticeable at the higher speeds, and one can readily see the effect that this has on the track. Furthermore, the condition of the track has a marked effect upon the magnitude of the thrusts, both lateral and vertical, which are imposed upon it. A locomotive running at 70 m.p.h. over a section of tangent track that had been roughened artificially so that one rail was ⅝ in. higher than the other in a distance of about 45 ft., and with reversals of the cross-level at each end, produced a measured lateral force of about 44,000 lb. in the direction of the low-rail—the maximum thrust occurring, however, at about the point where the cross-level was reversed. A similar run with the same locomotive over the track before it had been roughened did not produce a lateral force above 7,000 lb.

While our knowledge of this subject is not yet complete, the data that we have been able to secure indicate that the forces acting upon the track, both vertical and horizontal, increase materially with the higher speeds, varying from directly as the speed in some cases, to increases more nearly in proportion as the square of the speed, depending very largely upon the design of the equipment. Even with well-designed equipment, we are confronted with an engineering problem of some magnitude.

In order to meet the additional requirements caused by higher speeds, we have made a number of improvements in our track. When the railroads were built, little was done in the way of preparing a foundation for the track. The natural ground surface was leveled off to the established grade and to a certain width, usually inadequate for present traffic. Waterways were provided, but not much was done in the way of soil study for the provision of proper materials in the fills and in the subgrade, or for lowering the water table sufficiently far below the ballast to avoid soft soil conditions inadequate to sustain the pressures that were later to be imposed upon it by heavier traffic.

Some of you may have noticed the ditching work being done on the Pennsylvania between New York and Philadelphia. If you have, you may wonder why it is necessary to make ditches so deep below the level of the track. The reason is that this track is laid across a series of swamps with ground of higher elevation between them. Since there is very little natural fall, long ditches are required at many points to lower the water table sufficiently, resulting in the lower ends of these ditches being quite a distance below the track level. When we build new track today, either new lines or in connection with changes in alinement, we usually prepare the subgrade by providing a heavy layer of rolled cinders. On existing tracks, the lowering of the general level of ground water and the drainage of water pockets have greatly consolidated and stabilized the roadbed. A great deal of bank widening has also been necessary.

Increased Attention to Ties

Where speeds have been increased, we have found it essential to widen our ballast shoulders. An additional 6 in. to 12 in. has been placed on all shoulders in our electrified teritory, and the track is kept well filled with ballast at all times. This not only provides in-

The Latest in Streamlined, High-Speed Steam Locomotives on the Pennsylvania—Streamlined or Not, Heavy Power Operated at High Speeds Demands High-Grade Track
Photo courtesy P. R. R.

creased lateral resistance, but also retards to a considerable extent vibration and movement of the ties.

Increased Attention to Ties

No one knows how long properly treated ties will serve in clean, well-drained ballast. Effective chemicals can be injected in sufficient quantity to insure resistance to decay beyond any probable period of resistance to traffic stresses. The practical elimination of abrasion and splitting is engaging our attention. We have designed tie plates with ample bearing area and rounded edges at their ends. The bottoms of these plates also are free of any projections sharp enough to sever the wood fibres. They are broadly waved on the theory that their shallow settlement into the ties will bend, but not break the wood fibres, and that this slightly uneven surface will contribute resistance to lateral shifting. As a further help toward holding the plates firmly in place, we have very substantially increased the number of anchor spikes used.

The destruction of ties in track by spiking and traffic stresses is generally aggravated by splitting, which starts before the ties are creosoted. To avoid excessive shrinkage during seasoning, which causes most vertical splits, we require the flattening of the sides of the large ties, thus removing the surplus sapwood which shrinks longitudinally and pulls the ends apart. Furthermore, we promptly apply anti-splitting irons towards the top and the bottom of both ends of ties to prevent any splits from extending farther inward than the irons. This is done because we found that a single iron inserted near the middle of the end, permits a split, starting at either the top or bottom, to reach the middle of the tie. When this stage is reached, the split is usually so large and so filled with small stones, cinders and other material, as well as moisture, that the forces wedging it open, largely vibration and freezing, overcome the effectiveness of the single iron. I believe that with our heavy rail and large double-shoulder tie plate, and the reduction being brought about in the splitting of ties, we will get at least 25 years service from creosoted crossties.

The value of a heavy stiff rail, with high inertia to absorb vibration is proved by our experience with the 152-lb. rail. The resistance offered to lateral, as well as vertical forces, minimizes the wave motion in the rail and adds materially to the stability of the track and to freedom from distortion.

Above—A Joint in the 152-Lb. Rail Territory Between New York and Washington, D.C. —Note the Upset Joint Plate. Right —Widening the Throat of a Frog to Reduce the Force of Wheel Blows—The Grinder's Helper Is Essentially a Watchman

The surface of the wheel is kept smooth by the action of the brake shoes. The rail, however, is subject to wheel burns, corrugations and minor distortions in the metal caused by excessive wheel pressures. The treatment of the rail surface by grinding to remove these defects is expected to provide a better rolling contact condition and to reduce the amount of vibration in the rail, both of which will have a favorable effect on maintenance costs and the life of the rail. Also, by such treatment, considerable noise should be eliminated. To continue experimental work in this connection, especially that carried out by the Lehigh Valley Railroad, we have constructed a special rail grinding car, which will be put in operation soon.

The 36-in. and 38-in. joint bars that we are now using have been very satisfactory. We do not space ties, but we do provide a support for the rail ends where they come between ties. This is accomplished by the use of a long plate of tie plate section, but deformed upward in the central portion to provide greater strength.

Curve Conditions Important

One of the very noticeable things under high speed operation is that defects in alinement and in the superelevation of curves, not readily discernible by eye, sometimes cause very uncomfortable riding. Frequent checking with level-board and string is needed, therefore, to keep curves properly lined. This is true particularly with regard to the approach and run-off. On these portions of the curve, both the superelevation and alinement must increase or decrease with absolute regularity, and at every point there must be the same relation of alinement to superelevation as exists on the main body of the curve. A slight difference makes an unbalanced condition which, under frequent fast traffic, soon increases. It is a fact, however, that once the proper relationship is established, it does not become distorted easily.

These adjustments are particularly difficult at reverse curves with little tangent between them. Some curves are elevated for the comfortable speed, that is, 3 in. less than for equilibrium. On others, 90 per cent

of the comfortable speed is allowed. The latter is our standard practice. If the speed allowed is anything more than the equilibrium speed, you can see how this lack of true balance of equipment will be shifted quickly from one side of the track to the other. For this reason, tangents between curves must be of sufficient length to allow time to accomplish this shift without discomfort.

In realining curves to secure suitable approaches and run-offs, or in any marked shifting of track from its normal bed, care must be taken to restore the fully tamped condition under the tie, as well as to restore the full ballast section, in order to insure sufficient lateral resistance to the track under traffic. The action of a panel of track in which there is a loose portion, even though it may be only one or two ties in extent, when subjected to constant wheel loads at high speed, can readily be visualized. The excess movement in the loose portion is quickly communicated to adjacent sections and the deterioration of the track progresses rapidly. For this reason, great care must be used to secure uniform tamping and to maintain a stable condition of the ballast about each tie.

Other Factors

I have called attention to the action of certain types of equipment upon tangent track when operated at high speed. The electric locomotive at 90 m.p.h. travels 132 ft. per sec., and moves across from one rail to the other in about 40 ft. These cycles are very uniform, and in this distance considerable energy is built up in this heavy unit to thrust against the opposite rail. For this reason the gage on high-speed tangents should be maintained neat, and wide gage avoided, for any widening of the gage increases the length of the oscillations, increases the time interval during which energy is accumulated, and thus increases the magnitude of the thrust against the opposite rail.

We have designed and installed a number of switches 45 ft. long. They are operated by the usual operating rod near the point and by an auxiliary operating rod 23 ft. 3⅛ in. back from the point to insure their fitting tight against the stock rail from the point to the separation of the heads. When in this position, the lead curve is uniform from the point of the switch to the frog. The angle at the point has been materially reduced, and the riding quality of the turnout very much improved. We also widen the throat of frogs to 2⅜ in. to reduce the blow delivered by wheels entering the flangeway at high speed.

Any move toward higher speed in automatic signal territory involves prior signal changes to provide proper braking distance and, in some territories, this involves considerable expense. As an adjunct to our signals in high-speed cab-signal territory, we have recently put in operation so-called dragging equipment detectors. These devices are placed about 8,000 ft. in advance of our main track interlockings. An engineer moving his train over one of these devices without getting a restrictive indication on his cab signal has reasonable assurance that there are no parts of the train equipment dragging or hanging down to the level of the rails. As insurance, these devices are well worth while.

I have outlined some of the work that we have done to strengthen the track so that high-speed trains can be operated with safety and comfort,

Above—Exceptionally Deep Ditching is Essential to Stable Track at Many Locations. Left—Keeping High-Speed Track in Uniformly Good Surface is an Important Essential

but there are many other ways in which we are affected by high train speeds. With the inauguration of electric service between New York and Washington, D. C., with higher speeds, more rapid acceleration and quieter operation, the question of safety to men working on or about the tracks required careful study. As a result of this study, all of our safety rules were revised and, in many cases, amplified. Furthermore, more than 50 additional gang watchmen were employed, and each of these men was given a white disc to make his signals more distinct and unmistakable.

Circuits controlling flasher lights and warning bells at crossings to inform watchmen of the approach of trains, were lengthened. Whistle boards were attached to catenary poles at a higher and more convenient location than formerly.

Slow Orders Costly

An increase of 10 to 15 m.p.h. in maximum speed immediately brings into prominence existing speed restrictions. They are much more noticeable and costly under high-speed operation since the train energy lost is considerably greater. The elimination of a speed restriction of 60 m.p.h. for a distance of 1.05 mile, thereby permitting the maintenance of a speed of 90 m.p.h. where the restriction had existed, results in the saving in operation of 122.05 kw.hr. for a train of 8 passenger cars and one of our GG-1

(Continued on page 480)

Arc Welding Field Splices on Large Steel Piling

Good Practice in Structural Welding

BECAUSE of the advance in the knowledge and art of welding, particularly arc welding, the production of filler metal of a superior grade, and the development of fluxed electrodes, reliable welds may now be secured and definite results obtained by qualified welders working under careful procedure control. Gas welding has the advantage of requiring lighter, less expensive, and more easily transported equipment than the arc process. It has the disadvantages of slower operation and of requiring the heating of a larger amount of the base metal. It should not be used for welding parts while under stress as there may be danger of permanent distortion. Arc welding should be used for work of considerable magnitude. It is usually done with direct current, but the use of alternating current is increasing because of its greater availability.

The new specifications of the American Welding Society limit the welding of structural steel to base metal with a maximum carbon content of 0.25 per cent. Steel with higher carbon content and various alloy steels may be welded, but the technic and the filler metal for some of them still are in the experimental stage. Cast steel, cast iron and wrought iron may be welded, a slightly different filler metal and method of operation being required for each. The strength of a wrought iron plate cannot be developed readily by a fillet weld because of the fibrous nature of the iron.

A.R.E.A. committee reviews advantages and limitations, and shows where and how it can be applied in repairing and strengthening existing bridges and other types of steel work.

Filler metal may be of various compositions, the basis for acceptance being its physical properties and the properties of the resulting welds. At the present time there does not seem to be any reason for a specification for chemical composition, but for information and future use a record should be made of all the kinds of rods used, together with the location of their welds in the structure.

Filler metal is supplied in the form of wire rod, bare, washed, or covered with various organic and mineral compositions. The object of the covering is twofold: (1) Shrouding the arc excludes air from the molten metal, and (2) a coating of slag is deposited on top of the bead. The first is of benefit in producing a denser and cleaner deposit; the second in prolonging the time of cooling, thus having a slight annealing effect. The washed rod deposits a slag but does not shroud the arc. Another effect of shrouding is to

*Abstracted from a report presented as information by the Committee on Iron and Steel Structures before the convention of the American Railway Engineering Association on March 17, 1937.

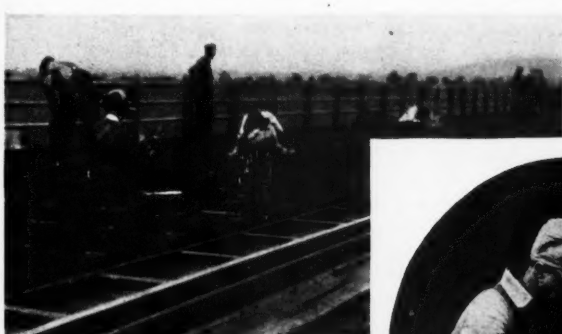
prevent dissipation of heat, thereby increasing the rate of deposition of the metal. Welds made with covered rods are stronger and more ductile than those made with bare rods but the danger of undercutting is greater.

Welds are of two types, butt welds and fillet welds. Butt welds resist deformation by direct tension or compression. Fillet welds resist deformation by shear. A fillet weld transverse to the line of stress resists partly by shear and partly by tension and therefore is stronger than an equal area of longitudinal fillet weld. The relation between resistance to shear and to tension is the same for filler metal as for base metal; hence a butt weld is stronger than an equal area of fillet weld. Tests show that the ordinary ratio of tension to shear in metals applies also to welds.

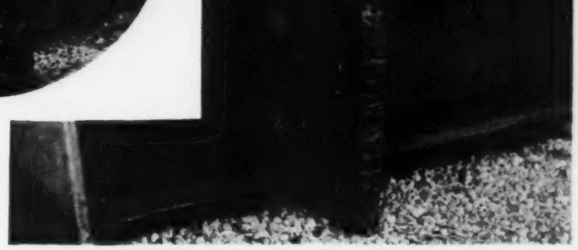
Stresses

Welding as applied to steel structures is a comparatively new development, but enough tests have been made to establish the strength of welds under static loads. While studies of the effect of impact and of repeated and reversed loads have been made, more tests and studies are needed. The specifications of the American Welding Society determine the working units for welds by formulas developed from the results of endurance tests.

Due to the nature of the process of welding, small areas of base metal are heated to the fusion point and adjacent areas to a lower temperature. This heating causes expansion and the subsequent cooling causes shrinkage of the base and filler metals. The stresses resulting are sometimes of considerable magnitude. The effect of these locked-up stresses on the load-carrying capacity of the welded member has been investigated to some extent and some tests of full-size columns showed that the load-carrying capacity was not reduced. Much additional investigation in this field is needed.



Left—Welding a Floor Grid to the Top Flanges of Floor Stringers



Above — Repairing Corroded Stiffeners and Below—the Result

Locked-up stresses can be reduced by certain stress-relieving procedures. Heat treatment is used in shop practice for some types of structures, but is generally not feasible for field welding. Peening the weld will relieve the stress in the weld to some extent but does not relieve the stress in the member. Locked-up stresses may be avoided to some extent if the parts are free to move during the process of welding. In this case the parts or the member as a whole may be distorted as a result of expansion and contraction. Distortion may be minimized by employing a sequence of welding procedure that will equalize the distribution of heat and also permit the parts to cool before the further application of heat.

Abrupt changes of section are points of concentrated stress. Change from one section to another should be gradual. The end of a weld should be tapered off, either by filling the crater or by planing.

Any economy of welding over riveting usually results from the saving of material. Where the cost of material is high and that of labor low, the welded structure may be the cheaper. This applies particularly to new construction. In the repair or reinforcement of existing structures the case is somewhat different. The saving of material is important, but the advantage of working without interfering with traffic or taking the structure out of service, or even without removing parts, may overbalance any increased cost of material.

Joints should be designed especially for welding. Parts may be directly connected without connecting flanges and splice plates. The omission of rivet holes effects a saving of section. There may be situations where the use of gusset plates and connecting angles will serve to reduce the concentration of stress.

Qualification and Tests

The specifications of the American Welding Society prescribe tests for welders to be made both before and during the progress of the work. These tests are for the purpose of demonstrating the ability of the welder to make acceptable welds and to check any tendency toward carelessness as the work proceeds.

Tests of materials also are prescribed to show the weldability of the base metal and the suitability of the filler material. These tests should be made and the records kept for all work of magnitude or importance.

Inspection

Various methods of inspection have been developed, but the method most generally applied is visual inspection. Visual inspection requires men trained to know the qualities of welds and who are generally capable themselves of making good welds. It is important that there should be enough trained inspectors to cover the job and to keep the work of all the welders under practically continual observation.

There are a number of all-welded railway and highway bridges now in service in the United States, including railway bascule and highway swing bridges, but these embrace spans of moderate length. In building work welding has been used more extensively. However, by far the greatest use of welding as applied to railway bridges and structures, both in the United States and abroad, is for

repairs and strengthening. Repair work usually involves some strengthening; the structure may be merely restored to its original strength, but it usually happens that some material will be added so that the load-carrying capacity of the structure is increased. Some of the items of repair and strengthening may be noted briefly:

Cracks in flange angles are repaired by vee-ing and butt-welding. A short, triangular plate should be added at each end of the crack to prevent its extension.

A corroded stiffener angle may have its bearing area restored or increased by welding a plate to the outstanding leg or by flame-cutting away a portion of the corroded leg and butt-welding a plate in place of the removed portion. New stiffeners may be added. They may be flats instead of angles and need not be milled to fit the flanges. Bearing is best secured by welding a short plate across the outside edge of the stiffener and to the flange. A good stiffener is a "T" with the stem of the "T" fillet-welded to the web. If bearing is not required, the stiffener should be cut short.

Corroded lacing bars may be flame-cut from the member and new bars welded in place without removing the rivets.

New sole plates may replace old ones, and are attached by welding them to the edges of the flanges. The use of countersunk rivets will thereby be avoided. Water may be excluded from open holes by welding in a rivet punching. Holes should not be filled with weld metal because this will produce points of large stress concentration.

A broken or cut-back corroded anchor bolt may have a piece of rod welded to the end and a nut welded on the rod.

Reinforcing Cover Plates

Cover plates may be added to girder flanges to increase the section modulus of the girder. If there is no traffic interference, cover plates on the top flange should be successively narrower and those on the bottom flange successively wider to permit downhand welding. If traffic is to be maintained, it is usually cheaper to make the top cover plates of a deck girder wider and weld overhead. If the flange is wide it may be necessary to place slot welds between the fillet welds. If there are rivets in the flange, holes large enough to receive the rivet heads should be punched in the plate. If the plate requires an intermediate weld a fillet weld may be run around the perimeter of the hole and the balance of the hole containing the rivet head filled with plastic cement if it is so situated as to hold water. The abrupt change of section at the end of a plate is a point of concentrated stress, but this may be lessened by tapering the plate and ending it with a curve. Plates should be clamped tightly to the flange while the weld is being made and both edges should be welded simultaneously in short stretches.

Flange rivets, splice plate rivets, and beam connection rivets may be reinforced by fillet welds along the edges of the plate or angle. Beam connections may be reinforced by adding shelf angles or brackets if clearance allows.

Girder webs may be reinforced by butt-welding plates between the flanges and fillet-welding them to the web. Special care is required in planning a sequence of welding that will minimize distortion. Slot welds may be required.

Protection of floor members against brine corrosion may be secured by tack-welding thin sheets over the tops of flanges and to the webs of floor beams.

Other Details

Gas-corroded overhead bracing may be repaired by cutting out the corroded parts and welding new sections in place. Corroded laterals and lateral plates may be replaced without cutting out flange rivets. Chord and web members may be reinforced by adding web plates or cover plates. Pairs of tension members may be made to resist compression by welding diaphragms between them or by connecting them by battens or lacing bars.

Worn pins may be wedged and welded. The bearing area may be increased by welding additional pin plates to the member. Loose eyebars may be cut and shortened. In this way two bars of a pair may be made to take equal stress. Elaborate methods for handling such problems have been developed by welding specialists.

Corroded rivet heads may be built up by welding, thereby avoiding the removal and redriving of the rivets. It should be recognized that this is not a means of reinforcing the rivet but only of preventing further reduction by corrosion. The clamping effect of a driven rivet cannot be restored by welding on a new head.

Building up imperfect castings and filling cavities in castings by welding is now an accepted practice. Broken machine parts may be repaired without dismantling the machine if the break is accessible. Worn and broken gear teeth may be restored. Broken gear teeth in the operating girder of a bascule bridge have been so repaired without interfering with the operation of the bridge. Where a large section of a tooth is broken out studs may be inserted, the weld metal built up around the studs, and the tooth finished to exact section by grinding.

The welding of castings usually causes embrittlement. For that reason castings, if of considerable size and subject to stress, should be annealed after welding.

Advantages and Disadvantages

The foregoing examples give an idea of the great variety of repair and reinforcement work that may be accomplished by the application of fusion welding. In most cases not only is the actual cost less than for riveted work but the non-interference with traffic makes for convenience and economy. The time required usually is less, and in many cases riveted repairs would involve the removal of the member from the structure and its subsequent replacement, while welding avoids this.

Welding is desirable in residential and business districts, where the noise of riveting is objectionable.

In most cases it is not necessary to provide temporary supports for the track or structure, or to relieve the member of dead-load stress. Loading tests have shown by strain gage measurements that the added material takes its proportionate share of the live load. Below the yield point, strain is proportional to stress; therefore both old and new metal are equally stressed by the live load. However, there are situations where it may be advisable to relieve the member from stress while making the weld. Tests on small specimens have shown that under heavy direct tension or compression a large weld, particularly if at right angles to the line of stress, may weaken the member so that it will fail by stretching or buckling while hot. Fillet welds transverse to the line of stress may decrease the fatigue resistance.

At the temperature of fusion the metal is molten. The saving characteristic of electric arc fusion is that the area affected at one time is small and the effect continues for only a few seconds. Gas welding does not have these favorable characteristics and hence should not be used for welding members under stress.

Another feature that should be kept in mind is the difference in the

(Continued on page 480)

How Many Paint Brushes?

D. & H. Reduces 200 Types to 47

By C. M. BURPEE*

More than two years ago this road undertook a study of its paint-brush buying practices with the object of determining if they could be improved upon. The committee that conducted the investigation decided against the use of orthodox specifications and developed a method under which brushes for practically every railway use are obtained from manufacturers' standard stocks.

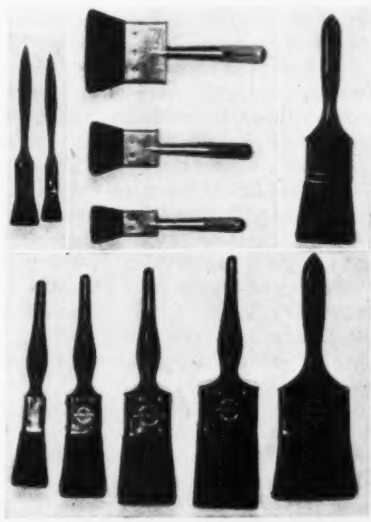
OUR methods of requisitioning and purchasing paint and varnish brushes had always occasioned more or less difficulty, and a study of our purchasing records indicated that during a five-year period we purchased more than 200 different kinds of brushes. With the object of bringing to an end this obviously uneconomic state of affairs a committee was appointed about two years ago, with the writer as chairman, to investigate the matter and to prepare specifications governing the manufacture and purchase of paint and varnish brushes.

Through inquiries we learned that many large industrial concerns do not have their own specifications but select brushes from manufacturers' standard stocks. Correspondence also indicated that among railways the accepted method of handling the matter was through the use of individual specifications. After a perusal of the various standards it became evident that, unless a specification was to be prepared from a study of those at hand, it would be necessary to secure first-hand information with regard to the materials and the manufacturing processes involved. Accordingly the committee visited six paint brush factories.

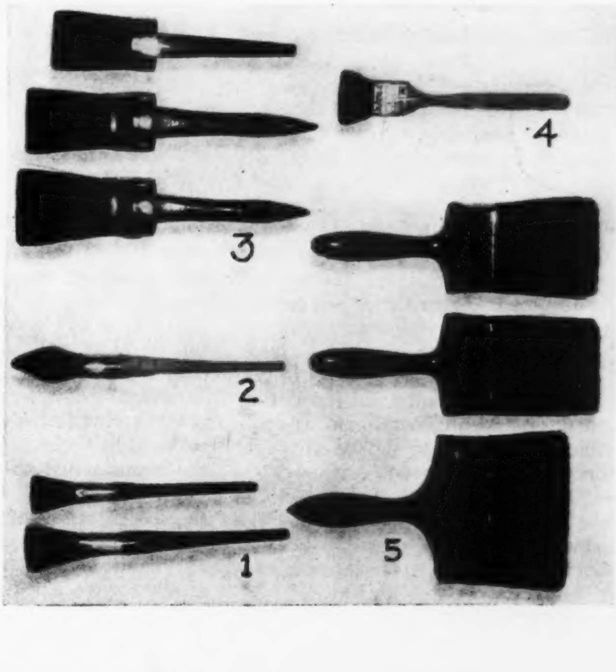
The result of these various visits was most beneficial. We had the opportunity of watching the manufacture of brushes and of obtaining from experts information on bristles, hair, fibre, ferrules, handles and other articles used, and on the various methods of manufacture. These conversations were carried on not only with the officers and supervisory forces, but also with the workmen. In this way we were able to familiarize ourselves with each step in the manufacturing process, from the arrival of foreign bristles and various forms of hair at the plant through the various processes until the finished product was packed in standard-size packages ready for distribution.

Government Specifications

Our preliminary investigation also included a visit to the national Bureau of Standards at Washington, D. C., where we learned that there are no less than three sets of government specifications covering brushes, one of which pertains to brushes used by the navy, another to those used by the army and the third to brushes used for general requirements. In a discussion with the government bristle expert, who is responsible for the government's



Top Left—Flat Sign Writer. Top Middle—Flowing. Top Right—Flat Utility. Bottom—Flat Varnish.



These and Other Views Accompanying this Article Show Brushes That Conform to the D. & H. Standards. 1. Flat Varnish. 2. Water or Gasoline. 3. Oval Paint and Varnish. 4. Bronzing. 5. Wall

*At the time this investigation was made and the article written, Mr. Burpee was research engineer of the Delaware & Hudson, in which capacity he acted as chairman of its investigating committee. He has since become connected with the Chipman Chemical Company as vice-president of the Railroad division at Chicago.

brush specifications, we discovered that these specifications were prepared in collaboration with a representative of a prominent manufacturer after the expert had spent considerable time in and about the brush factory.

After these visits the committee was in much better position to study the problems and requirements peculiar to our road. While a standard specification prepared several years ago was supposed to govern the greater part of our requirements for brushes, it developed that many brushes were ordered for special purposes, and that entirely different brushes were used at different locations for identical purposes. In many instances brushes were requisitioned by trade names, the user stating his preference for certain brushes; in others the choice was left to the purchasing department.

It was found, for instance, that a comparatively cheap 4-in. wall brush costing $11.40 per dozen was being furnished to maintenance of way painters, while the general office building was being supplied with a brush of similar size costing $22.50 per dozen. The latter type of brush gave good service, whereas the former was, in the final analysis, an expensive type, it lacked durability and, because of the small amount of bristle which it contained and its short length, the painters could not do a good job with it. It should be recognized that maintenance of way painters require wall brushes that will render good service, since they use the brushes continuously during a considerable portion of the year.

Forty-Seven Brushes

The matter was taken up separately with each using department and a list of the brush requirements of each department was prepared. A tentative list of standard brushes was then compiled, which was based principally upon size, a general description of quality, and the purposes for which the brushes were required. Later a meeting was held at which the various using departments were represented by painter supervisors or foremen. At this meeting certain compromises were effected to the end that the same brush could be used for several different purposes in two or more departments and for similar purposes at all locations. In this manner a standard list of all paint brushes was prepared.

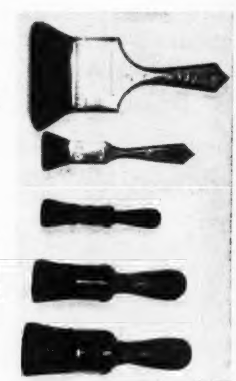
During the course of the meetings the committee avoided dictating the adoption of any particular brushes but sought rather to achieve such action through compromise and general co-operation. In this manner it was found that 47 different brushes would serve all purposes, or 165 less than the number previously purchased. It must be remembered, however, that, while it is good policy to reduce the number of items in any one list to a minimum, that minimum must not be such as to interfere with the efficient and economical use of painting labor.

Why Have Specifications?

In an attempt to standardize the sizes and quality of the 47 selected brushes, a study was made of the catalogues describing the standard stock brushes of five manufacturers. It was soon apparent, however, that no such standardization, even with regard to size, existed; railroad specifications varied considerably from each other and also from the catalogued sizes. At this point the committee was confronted with the question: What do paint-brush specifications involve? After its experiences the committee was unanimously of the opinion that it would be a decided error to attempt to prepare the orthodox form of specifications to be followed by reputable manufacturers who had been engaged in the business of making brushes for generations. Surely such people were much better qualified to prepare specifications and to supervise the manufacture of brushes than any railway men could be after a superficial study of the subject. Furthermore, the adoption and use of specifications would require inspection of the product at the manufacturing plant by railway inspectors.

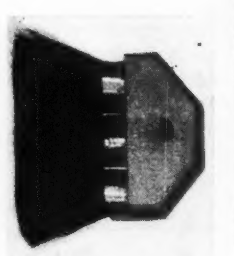
Several examples come to mind of what can happen when railroads seek to establish close supervision over the manufacture of brushes. At one plant we had seen brushes made to the specifications of a particular railroad, which were rejected because the handles were 1/8 in. too short. In another case brushes were rejected because the handles were 1/16 in. too wide. Another lot was rejected because the cement extended 1/8 in. beyond the ferrules. In still another instance an inspector traveled over 250 miles (one way) to a factory to inspect an order of brushes that totalled under two dollars in value. When time and money are wasted on such minor details it is evident that incorrect methods of purchasing are being followed.

In one of the factories visited by the committee the quality of the brushes was found to be so poor that the name of the company was removed from our list of desirable sources of supply. And yet we were shown railroad brushes in that factory in the course of manufacture, and records of business transactions indicating that several railways were continuing to buy paint brushes to their standard specifications from that factory. While many railways are buying brushes to specifications, we believe that very few, if any, railway inspectors have a sufficient command of the subject to permit them to pit their knowledge and experience against that of manufacturers' employees who have devoted a lifetime to the business.



Right—Color. Lower Right—Stencil

Below—Roof Brush



Upper Left—Painter Duster. Left — Kalsomine

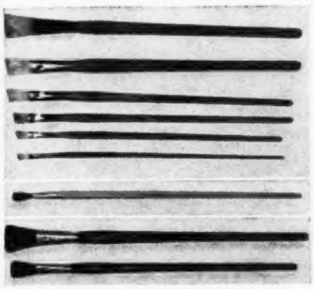
"Descriptive List" Compiled

With these considerations in mind it occurred to the committee that the manufacturers should be able to supply suitable brushes for the various purposes, if provided with a general description of the quality of the brushes and a statement of the purposes for which they were intended. It was decided, therefore, to abandon

the idea of a specification and in its stead prepare what we termed a "descriptive list" which would define all requirements clearly and briefly. It appeared that all of our brushes could be included in one of three quality groups. The first section of the list, therefore, comprised a definition of these three classifications. They are as follows:

Best Quality. Shall be interpreted as meaning the best brush, in the opinion of the manufacturer, to serve the purpose intended; to be used by master painters.

Medium Quality. Shall be interpreted as meaning a brush of average



Top—Angular. Middle—Round Marking. Bottom—Flat Artist

service life, which will, in the opinion of the manufacturer, prove satisfactory to the workman for the service intended. Brushes of this quality may or may not be used by a master painter.

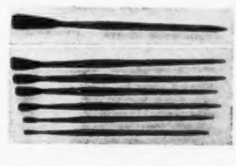
Good Quality. Shall be interpreted as meaning a brush for occasional use by workmen for less exacting service.

All brushes were divided into named classes, depending upon their use, and each was given a number. The use of each class was defined, together with the quality desired and all necessary measurements. By comparing our notes on the desired sizes with information given in the various catalogues, a series of mean dimensions was arrived at and used in the preparation of our descriptive list. By this time we were firmly convinced that our requirements could be furnished from the regular standard stock brushes of several different manufacturers without resorting to special specifications.

Our completed descriptive list of standard paint and varnish brushes was adopted by the management and issued as part of an executive order, so that, in this manner, the standards were definitely established. In the course of our report it was recommended that only five of the factories which we had visited be considered as sources of supply so that when the matter was referred to the purchasing department arrangements were made accordingly. The descriptive list was sent to the manufacturers, together with a letter informing them that it was not to be considered in any way as a specification but rather as a guide. They were requested to select sample brushes from their standard stocks and have them presented, together with prices, to the committee.

Rating of Brushes

At this point one of our general painter foremen was added to the committee, and an individual examination and rating was made of each



Striping Pencil (Top) and Lettering Pencil (Bottom)

sample by each member of the committee. In rating the brushes the primary considerations were quality and suitability for the purpose intended, with price being used as a final means of rating if two or more brushes were otherwise considered equal. The majority opinion ruled and was considered as representing the findings of the committee. In this manner hundreds of brushes were examined and a summary of the ratings was prepared.

Numerous brushes were rejected, but finally line samples of three manufacturers were recommended to the purchasing department as suitable. The purchasing agent contracted with one of these concerns to supply our requirements for a year, and furnished a list of the estimated quantities which would be required during that period. With the exception of two, all brushes approved were of the manufacturer's standards and arrangements were made to carry a small stock of the exceptions, in addition to the standard line, at the local warehouse of the supplier. The approved sample line was turned over to the stores department so that, in the event of complaints, comparisons could be made from time to time with incoming shipments.

Method Found Satisfactory

This method of selection and purchase has now been in use for about two years and the satisfactory manner in which the plan has operated has occasioned some surprise, even among the members of the committee. The application of any new method is expected to encounter some difficulties and to be the cause of some complaints; in this case, however, these were minor in character and few in number.

As a result of the application of the new plan, the purchase of paint brushes now requires a minimum of attention and is handled regularly as a part of the normal office routine. Other advantages of the plan are

Sample of Details of Descriptive List

Flowing

Best quality brush of prepared fitch hair and black Chinese bristle, double thick, cup chiseled, vulcanized in rubber, metal ferrule.

Use: General—including sash, panels, interior and exterior of passenger cars, and fine work.

D. & H. Brush No.	Width of hair inside of ferrule in inches	Thickness of hair inside of ferrule in inches	Length of hair outside of ferrule in inches
21	1	⅜	1⅜
22	1½	7/16	1½
23	2½	½	1¾

Flat Varnish

Brushes No. 24, 25, 26 and 27 shall be of best quality, black Chinese bristle, triple thick, full brush, no strips, cup chiseled, vulcanized in rubber.

Brush No. 28 shall be of medium quality, black Chinese bristle, double thick, no strips, cup chiseled, vulcanized in rubber.

Use: General application of varnish to baggage car sash, the interiors of stations, building sash and furniture and enamel to deck screens of cars.

D. & H. Brush No.	Width of brush inside of ferrule in inches	Thickness of brush inside of ferrule in inches	Length of bristle outside of ferrule in inches
24	1	⅝	2¼
25	1½	⅝	2½
26	2	1 1/16	2¾
27	2½	¾	3
28	3	½	2⅜

Flat Utility

Good quality brush of black Chinese bristle, vulcanized in rubber, metal ferrule.

Use: For applying oil to track fastenings and for other purposes where a cheap varnish or paint brush is desired.

D. & H. Brush No.	Width of brush inside of ferrule in inches	Length of bristle outside of ferrule in inches
29	2	1¾

given in the following paragraphs:

Reduces Stores Stock. Our standard brushes are found in the line standard of the manufacturer and as such are carried in his regular stock in his local warehouse.

Quick Shipment and Delivery. A telephone call will start a shipment on its way immediately; it is no longer necessary to wait for brushes to be manufactured to our specifications.

Saving Considerable

Saving in Cost. Even though in many instances the brushes bought under the new plan are of much better quality than similar kinds purchased in the past, a considerable saving in cost has been obtained. Heretofore our purchases of paint and varnish brushes were divided among nine different concerns, including jobbers and wholesalers, so that we were securing all sizes and types of brushes in small quantities, including many which were made to our special order or specification. Under the new scheme, competition is retained and, since all requirements are obtained from the same source for at least a year, and quantities are standard packages, the account is desirable from the manufacturer's viewpoint.

I had occasion to ask one of the representatives of a supply company what the difference in cost was between the company's standard line brushes and those manufactured in private specifications, to which he replied, "As you undoubtedly know, many factors enter into the determination of this percentage of saving, and careful consideration must be given to all of them to determine a fair percentage, which, of course, can only be an estimate. This matter has been given considerable thought and has been a subject of research here over a period of several years, and we have come to the conclusion that the saving is about 25 per cent."

Better Brushes of Stable Quality. Under the new plan we are receiving regular stock brushes from a reputable manufacturer who is considerably interested in maintaining the quality of trade-marked or branded articles. Moreover, the responsibility of furnishing brushes for specific purposes is his. Certainly a railroad man can tell what individual brushes are required for certain types of work, and he knows how and by whom they will be used, but it is entirely up to the manufacturer to make satisfactory brushes in accordance with methods developed by practice.

High-Speed Track

(Continued from page 473)

electric locomotives, with a total weight of 910 tons. This saving, at an estimated cost of 9/10 of a cent per kilowatt hour at the pantagraph shoe, totals $1.10 per train.

Because of the large possible losses due to speed restrictions, we have made a study of all existing speed restrictions to find the cost of eliminating them and the saving in time to be secured. These costs run from $50,000 to $500,000 or more per minute of time saved per train. Of course, the number of trains involved is a governing factor, along with the physical conditions existing in the territory considered, such as grades and the proximity of other speed restrictions.

Energy Savings

Then there are savings in energy possible through reduced curvature, decreased maintenance, and repairs to equipment. These are hard to estimate. One formula that is sometimes used in determining the effect of track curvature, is that of J. L. Campbell, chief engineer (retired), Northwestern Pacific, (American Railway Engineering Association Proceedings, Volume 27, Page 1227), who estimates that the effect of curvature in terms of distance is found by multiplying the total central angle of curvature in degrees by 0.0025. On this basis, the effect or cost of operating 400 deg. of curvature is the same as that for operating one mile of distance on tangent track. In several cases where a large number of trains are involved, we have felt justified in making an expenditure of approximately $100,000 to save one minute of time per train.

The studies and research work now progressing, through which we are learning more about the action of equipment upon the track, are bearing fruit. The knowledge developed by these studies is already being applied in the design of equipment. This will be of great benefit to the track, because it is definitely apparent that large savings in maintenance can be secured by improved equipment design.

Recent increases in speed have not put new problems up to maintenance men as much as they have intensified the old ones. It behooves us, therefore, first to be sure that what we think we do know is based upon facts that will stand all tests, and then to strive to learn more facts that may be useful under intensified conditions in the future.

Structural Welding

(Continued from page 476)

ways riveted joints and welded joints act. A riveted joint functions partly by friction and slips slightly before the rivets come into full bearing. In a welded joint no such slipping can take place. The welded joint is stiffer than the riveted joint and is therefore more affected by secondary stresses. Where a joint is partly riveted and partly welded this difference in manner of functioning should be taken into consideration. The specifications of the American Welding Society assume that all of the dead load is carried by the rivets and all of the live load by the weld. More experimental work is necessary to verify this.

Conclusion

It is apparent that the practice of welding is in advance of theory and somewhat ahead of exact knowledge. Welding offers a large field for research and experimental work, and a great deal is being done in all parts of the world. So much knowledge is now available that there need be no hesitation in applying welding in repairs and reinforcement. All-welded work should be adopted only after a thorough study, both technical and economic.

Consistent specifications should be adopted and rigidly enforced. Qualified operators and experienced inspectors should be employed. It is particularly necessary that the work be designed and the sequence of welding operations be outlined by a competent engineer who is experienced in fabricating welded steel structures.

The Specifications for Design, Construction and Repair of Highway and Railway Bridges by Fusion Welding of the American Welding Society for 1936, cover in detail the materials, equipment, processes, workmanship, and inspection of gas and arc welding as applied to bridgework, new or old. These specifications may be obtained from the American Welding Society, 33 West 39th Street, New York City.

Mounted on a Series of Skid Ties, Pairs of Long Welded Rails Were Sledded to Points of Installation

"Sledding"

The Latest in Long Rail Transportation

Confronted with the problem of moving long sections of Thermit-welded rails into position in the track, over distances up to a mile from the point of welding, the Brooklyn-Manhattan-Transit Lines, New York, developed a method of "sledding" the rails over the existing track, employing tie-plated ties at intervals of 40 to 50 ft. for sleds, and an electric locomotive for hauling power. Details of how the work was carried out are included herein.

THE advent of long welded rails has brought with it the attendant problem of handling and laying this rail. To solve this problem, the Brooklyn-Manhattan-Transit Lines, New York, employed a method recently on a section of its Sea Beach line, in Brooklyn, N.Y., which is entirely different from methods used heretofore in this country, and which proved entirely practicable. The company installed one mile of Thermit-pressure-welded track in conjunction with M. & L. tie plate construction, and, with the exception of one short section, moved all of the rail into place in lengths up to 600 ft. by "sledding" it along the existing track, utilizing tie-plated spare ties for the "sleds" and an electric locomotive for the pulling power. The rail was moved a maximum distance of approximately one mile, at a rate of six to eight miles an hour, and was spotted exactly at the point desired for laying.

Location of Welding

Owing to the dense traffic of the subway system and the fact that the rail was to be laid in a cut, walled in on one side, it was impossible to do the work in track or directly alongside the rail to be replaced. Therefore, for carrying out the welding, a location was selected in a side-hill cut, directly at one end of the job, where there was a narrow outside shoulder on which 1,000 ft. of low timber cribbing could be set up. This length was sufficient for the purpose since the lengths of welded rails to be handled were limited by the signal and automatic train control system blocks on the line, which are only approximately 600 ft. to 1,000 ft. long.

All of the Thermit joint welding

was done on the cribbing, on two strings of rails at a time, working progressively from one end to the other. In the grinding, which followed directly behind the welding, the sides of the rail head were given a finished surface, while the top of the head was only dressed off sufficiently to permit train operation, leaving the finish grinding to be done in track with a reciprocating car grinder. As each two lengths of welded rail were completed, they were shifted sidewise on the cribbing toward the adjacent operating track, and additional rails were set up on the cribbing.

The first two lengths of welded rails were used to replace the rails directly opposite the cribbing. This change-over, which involved merely the barring of the long rails laterally into the track as the old rails were lined out, was done without difficulty. Additional strings of rails were then accumulated at the same location on the cribbing as the original lengths.

Two Plans Considered

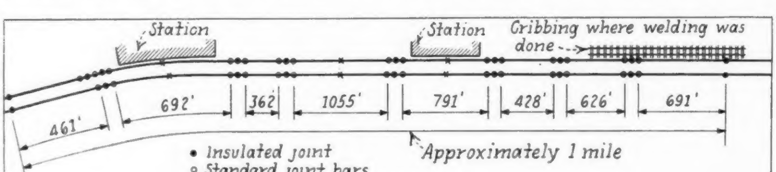
The section of line involved in the rail renewal work is four-track, the two center tracks being express tracks, used only during the summer months for carrying heavy traffic to the seashore at Coney Island, Brooklyn, while the outside tracks carry local traffic and are in constant use. Since the new rail was to be laid in one of the local tracks, this meant that the work had to be done within strictly limited time intervals between scheduled trains. However, since the express tracks were out of service, it being late fall when the work was done, these tracks were available for work train service. This proved a convenience, but was not essential to carrying out the work.

Two plans were considered for moving the long rails into position in the track, both of which required taking over the local track involved for short periods in the early hours of the morning when there was the greatest interval between trains. One plan called for the lifting or barring of the welded lengths to a position between the running rails of the local track, and then dragging them, one length at a time, along the track with an electric locomotive of the type used by the railway with its work trains. A preliminary test of this plan showed that the locomotive could easily drag one length, or even two lengths, but it was evident that the projections left on the bottom of the rail by the welding would scar the tops of the ties badly. Therefore, consideration of this method was dropped.

Sledding Plan Adopted

In the second method considered, which was adopted, it was planned to sled two welded lengths into position at a time on crossties laid across the tops of the running rails of the operating track. Old ties were secured for the purpose, and to facilitate the sledding, two double-shoulder tie plates were screw-spiked to each of them to standard gage. Enough of these ties were assembled in advance so that they could be spaced at intervals of 40 to 50 ft. beneath the welded rails.

The Welding Was Done Immediately Alongside — Note Welded Rail With M. & L. Fastenings Already in Operating Track



Sketch Diagram of the Welded Rail Installation on the B-M-T Lines—Note Short Length of Rail Each Side of Insulated Joints

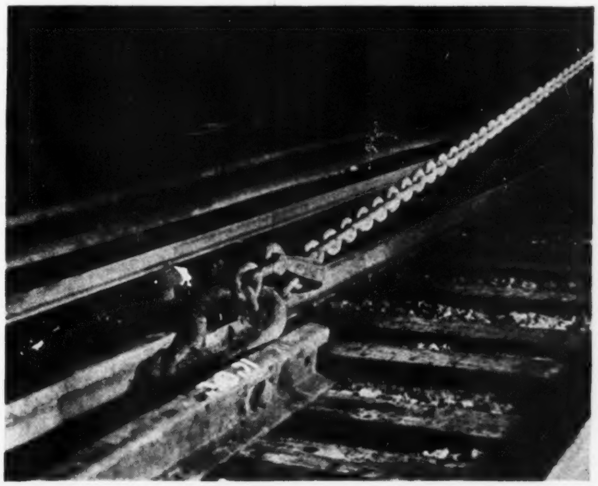
In order to permit the staggering of the joints in the track with minimum longitudinal shifting of the long rails, the rails were lined up in this relative position on the cribbing for welding. Then, just prior to moving each pair of long rails, a half-length of rail was coupled to the advance end of the shorter string by means of ordinary joint bars, which brought the two advance ends flush with each other. When ready to make the move, the advance ends of the two strings of rails were coupled together with a heavy yoke and bolt so that both strings could be pulled as a unit. Obviously, at the end of the move, the removal of the short length of rail left all joints in each line of rails staggered with those in the other lines, as desired, without the necessity for further longitudinal adjustment of either of the rails. In the actual moving of the pairs of long rails, the yoke joining them was coupled by means of a chain to a yoke attached to the rear end of the electric locomotive.

As soon as the track was taken over for moving the rails, which was usually about 1 a.m., the prepared "sled" ties were spaced along the existing running rails, with the tie plates turned downward and bearing on the running surface of the track rails. It was expected that the shoulders of the plates would act somewhat as wheel flanges and keep the ties from shifting sideways, while at the same time they would afford sufficient lateral play to permit the rails to be dragged around curves without binding. This proved to be correct.

Keeping the sled ties alined on the operating track was of utmost importance in view of the presence of live "third" rails alongside the track. Any abrupt lateral movement of these ties could have damaged the third-rail construction seriously, as well as have presented an electrical hazard. Since the third rails provided the necessary power for the locomotive pulling the long rails as well as for the work train used in conjunction with the work, it is obvious that they had to be kept alive.

With the ties in place, two strings

of welded rails were lifted by the work train crane on to the ties and were lined up about eight inches apart in the center portions of the ties. Each welded length was then spiked in position, and to prevent any possible shifting longitudinally, anti-creepers were applied to them behind each tie. One man with a spike maul was assigned to each tie, and a set of whistle signals was arranged so that the locomotive could be stopped promptly in the event that any of the ties should stick or otherwise cause trouble. Each man was to watch his particular tie, and in case it should tend to shift from a 90-deg. angle with the rail, he was to straighten it out with his maul.



The Pairs of Long Rails Were Joined at the Advance End and Were Pulled by an Electric Locomotive

Moves Made Smoothly

It was planned originally that the men should walk alongside the ties, since it was assumed that the movement would be so slow that they would have no trouble in keeping up. However, after the movement of the first pair of rails, the later moves proceeded so smoothly and quickly that the men rode their particular ties, their presence became more a matter of insurance than of necessity.

The first move started off at almost a crawl but ended up at a speed of about four miles an hour. Succeeding moves were made at speeds of six to eight miles an hour and no trouble was encountered other than the occasional slight shifting of a tie. Curves up to three degrees were negotiated easily and smoothly.

Before each move was made, the final end location of each string of rail was marked on either the old rail or the ties, and then when the welded lengths were brought up, they were stopped just short of the marks. From this point they were inched up to exact location by one or more easy starts and stops of the locomotive. Once spotted, the spikes holding the rails to the sled ties were pulled, and then the rails were lifted momentarily by the crane operating on the adjacent express track while the ties were slid out from under. This lowered the long rails onto the track ties between the running rails. The work train and the majority of the men, after loading the tie-plated ties, then returned for another pair of long rails. The men remaining spiked down the new rail at intervals to prevent any possibility of its shifting, and also spiked old joint bars slantingly at the ends to prevent the catching of any dragging equipment.

Altogether, 22 lengths of welded rails were sledded into position, the longest section being approximately 600 ft. long and the shortest about 330 ft. In several cases, two of the shorter sections were seam-welded together after being installed in the track. This was done by arc-welding 26-in. fish plates to both sides of the rail at the joints, as well as attaching an 8½-in. base plate directly beneath each joint by means of arc welding.

The maximum length of drag of the long sections of rail was about one mile and the average time consumed from clear track to clear track on each sledding movement was approximately 35 minutes. No damage was done to the surface of the running rails or to any other part of the track structure, and, in fact, the operations were carried out so smoothly and easily that it is felt by those in charge of the work that the method employed is entirely practicable and economical for the movement of long rails over much greater distances than those involved in the work described.

The installation of the welded lengths of rail in the track on the new M. & L. tie plates adopted for this section of line was carried out in operations distinctly separate from those involved in sledding in the rails. This work was done under traffic at night in successive intervals of about 20 minutes each between trains, and involved no special difficulties. One interesting feature of the rail as laid, however, is that at all insulated joints in the section of welded track, of which there are 15, as shown in the accompanying sketch, the joints are flanked on each side by short sections of rail, joined to the long welded rails by ordinary angle bars. This arrangement was adopted to permit ready maintenance of the insulated joints and renewal of the insulating end posts as may become necessary from time to time.

The installation of the M. & L. track and welded rails on the B-M-T Lines was made under the general direction of H. J. Kolb, chief engineer, and under the immediate supervision of P. Ney Wilson, superintendent of track. All of the welding was done with equipment and materials furnished by the Metal & Thermit Corporation, New York, while the M. & L. plate construction was furnished by the Rails Company, New Haven, Conn.

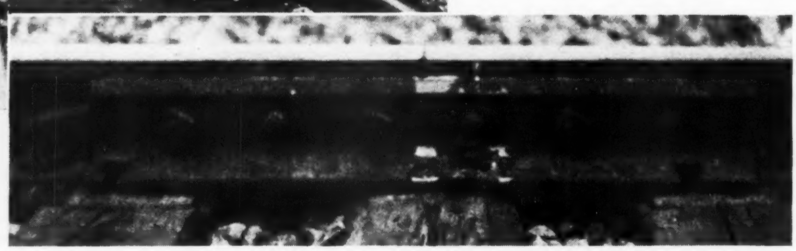
"Bad Order" Crossing Sign

A FATAL collision between a train of the Chicago, Springfield & St. Louis and a motor truck at a grade crossing in Springfield, Ill., on January 11, was ascribed by the Bureau of Safety of the Interstate Commerce Commission to lack of watchfulness on the part of the truck driver. However, the report directed attention to the inadequacy of the warning sign at this crossing, in the following terms:

"A crossing-warning sign of the cross-bar type is located in the southeast angle of the intersection at a point 18 ft. from the center of the track, on the edge of the highway. At the time of the accident one of the cross-bars was missing and the words 'RAIL ROAD' which appeared on the remaining bar were scarcely visible; in fact, it is doubtful whether one not familiar with the conditions would know that this was intended as a warning sign."

The bureau recommended that "immediate steps be taken to erect suitable crossing warning signs on each side of the track and to maintain them in proper condition to serve the purpose for which intended."

To overcome the corrosion of rail within the limits of the joint bars, which, because of the action of brine drippings and stoker ash has become a serious problem, the New York Central is packing the space back of the joint bars with an oil-wood flour mixture. The manner in which this work is being done and the results being accomplished, are described in this article.



Above — A Close-Up View of the Packing Machine in Operation.

Left—A Newly Packed Joint

Fighting Corrosion at Rail Joints

CONFRONTED with a problem of severe rail corrosion at rail joints over many miles of its lines, the New York Central is packing the space behind thousands of joint bars with a rust-inhibiting compound which excludes all moisture and other corroding substances, and which, at the same time, provides lubrication for normal rail expansion and contraction within the joints. Employing a recently developed power-operated machine, the road packed approximately 25,000 joints during 1936, and is now engaged in another sizeable program.

Severe Attack Behind Bars

For a number of years the Central has been troubled with the corrosion of rail and rail fastenings on many miles of line. This has been particularly severe on its eastbound main tracks, carrying heavily loaded refrigerator car traffic, and has been combatted quite successfully by spraying periodically the base and web of the rail, together with the rail joints, with a high-asphalt content road oil. With the exception of 1930, 1931 and 1932, this practice has been in effect for many years, employing a special spraying car pulled over the road with supply tank cars in a special oiling train.

While this practice has been effective in protecting the main exposed body of the rail, it has not afforded protection to that part of the rail obscured from view by the joint bars, which, in many cases, was found to be the most severely attacked by corrosion. This condition was found to be particularly prevalent on the main tracks of the Hudson division, between Albany, N. Y., and New York City, although it was also very noticeable on the main tracks west of Albany. Where this condition existed, the base of the rail in many cases was entirely corroded away along the edge, the corrosion tapering back toward the web. Many rails were so badly corroded behind the joint bars that they had to be scrapped, while others were removed and cropped for further use. But cropping, at best, was a costly expedient to overcome the trouble encountered, and, obviously, was not an adequate remedy.

Study of this condition made it evident that the severe corrosion was being brought about by two factors—brine drip from refrigerator cars, and the fine ash from stoker-fired locomotives, both of which were whipped

behind the joint bars by the action of passing trains. Tests made by the electrical department of the road showed that the ash and other foreign material behind the joint bars, mixed with brine drippings, remained damp for a long period and set up galvanic action, causing corrosion, while the stoker ash itself, containing sulphur, formed sulphuric acid when moist, with the same result. In view of these determinations, it was not surprising that the greatest corrosion was found in cuts and along banks where the ash was not blown from the track by prevailing winds, and where protection from the sun prevented quick drying out.

Another fact which became very noticeable was that when the corrosion reached a certain stage, its development became very rapid. Not infrequently, rail found in good condition in the fall was corroded seriously by the following spring.

The first attempt to combat the corrosion of the rail back of the joint bars, beyond the general machine spraying of the rail, was made in 1934 and 1935, when the road began experimenting with various means of direct protection of the rail within the joint area. In these experiments, hot road oil was sprayed behind the bars of a number of joints, and at other joints the bars were removed and, along with the rail, were painted with road oil or other types of protective coating. A test was also made of removing the bars and packing the space between them and the rail with a mixture of wood flour and road oil.

Study Packing Joints

Early in the spring of 1936, representatives of the road made an inspection of an experimental section of track on the Pennsylvania where a plastic mixture of finely divided wood flour and a residue oil of high asphalt content had been packed behind six-hole joint bars on 130-lb. rail to stop corrosion. The plastic material employed here had been introduced into the spaces behind the bars under pressure by a special machine, then in the experimental stage. The application of the material had been made in 1930, and at the time of the inspection, six years later, the removal of the joint bars showed no evidence of corrosion of the rails or the bars, and none of the bolts and fastenings showed deterioration. Furthermore, the material was still plastic, and although the bars had been pulled up as tight as possible, there was no evidence of "frozen" joints. Both the top and bottom fishing surfaces of the rails were found to be bright.

As a result of these tests on the Pennsylvania, plus its own experience along the same lines, the New York Central entered into a contract early in 1936 for the protection of approximately 25,000 127-lb. rail joints on its Hudson division, the method of application to consist of filling the spaces behind the bars with a plastic mixture of wood flour and oil, without removing the bars. The oil specified for the mixture was a road oil containing 45 per cent asphalt and 55 per cent distillates and volatiles. Oil of this character was selected because it was found that the disseminated distillates would penetrate any scale already formed, stopping further oxidation, and that the evaporation of the volatiles would leave a mass stiff enough to stay in place behind the bars and still remain in a plastic condition.

Special Machine Used

The joint-packing machine employed in carrying out the work consists of a four-wheel mounted, self-propelled power car carrying a large material hopper and a 60-hp. engine driving a cam pump. The packing compound is loaded into the hopper, and the pump then forces it at high pressure to special twin nozzles mounted over each line of rails. The nozzles, supported by a roller carriage, are designed to eject the compound from both sides through one of the bolt holes nearest the center of the bars, so that it will move both ways simultaneously to the ends of the bars on both sides of the rail and completely fill the spaces back of them. There is no tendency for the compound to flow of itself so that the application is continued until the plastic material shows at the ends of the bars. With nozzles located over each line of rails, and with the one bolt removed from each joint in advance, the application of the material is rapid, as many as five joints having been packed in a minute when testing the machine to capacity. Under normal working conditions, which includes all delays due to traffic and otherwise, an average of 140 joints were packed per hour during the New York Central work in 1936.

Special Set-Off

A factor in the daily production of the machine is the specially designed set-off with which it is equipped, which makes it possible to clear the track quickly for traffic, and to resume the packing operations shortly after the passage of trains. Another factor is the hand-winch derrick mounted on the car, which quickly loads the material hopper as necessary from 400-lb. drums. previously unloaded along the right-of-way at predetermined intervals.

The force employed in the joint packing work includes a foreman, an operator and seven trackmen. The trackmen assist the machine operator as necessary, but the largest part of their work is that of removing and replacing bolts.

Packing Joints on the Hudson Division to Overcome the Joint Corrosion Problem

The method of joint protection described and the machine employed in the work were developed and are controlled by the Railway Maintenance Corporation, Pittsburgh, Pa. This company is now developing nozzles to permit the introduction of the compound to the joints from the ends of the bars. The success of this development will eliminate the necessity for removing the bolt from the joint, which should reduce the cost of the work materially.

The work being done on the New

York Central has been carried out under the direction of J. V. Neubert, chief engineer maintenance of way, system, and W. A. Murray, engineer maintenance of way, Lines Buffalo and East, and under the immediate supervision of G. N. Edmondson, engineer of track, Lines Buffalo and East, and J. H. Kelly, division engineer of the Hudson division.

Inspecting Substructures*

By George E. Robinson

Assistant Engineer, Cleveland, Cincinnati, Chicago & St. Louis, Cincinnati, Ohio

WHEN inspecting masonry bridges and masonry substructures, the major items which should receive particular attention are (1) general alinement, (2) stream scour, (3) settlement, (4) disintegration, (5) erosion in pipes and on paved bridges, (6) movement at expansion and construction joints, (7) leakage and seepage of water, (8) operation of weep holes, (9) height and length of wings and evidence of movement, (10) condition and height of parapets, and (11) the pointing of stone masonry. While this looks like a formidable list, it does not exhaust the items that should be noted, such as the condition of the bridge seats, the cutwater nosing and plates and their anchorage, the condition of riprap, changes in stream bed, etc., all of which should be noted during the inspection.

An inspector should first note the horizontal and vertical alinement of abutments and piers, the grade and alinement of the deck and, in arches, the shape of the barrel and the grade line of the crown. Deviations from correct grade and alinement often afford a clue to other defects that are not readily discernible.

He should determine where the flow line is with respect to the foundation along the faces of the footings, as well as out in the channel, and look for holes in the channel. If there are holes under the bridge and on the downstream side of the bridge, this usually is an indication of insufficient waterway. If deep holes occur upstream they may result from some obstruction or channel characteristic which causes a swirl during periods of high water. Sometimes these upstream conditions, if not corrected, will endanger the structure or cause cutting of the embankment at the end of the bridge. It is also important to note whether the stream has been cutting into its banks at any point where it might endanger the wingwalls or the embankment.

Horizontal settlement of any complete unit, such as a pier or abutment, is usually difficult to determine by casual observation. There are times, however, when movement of this character will be indicated by cracks between the displaced unit and the unit it supports. Such settlement, when unaccompanied by scour, is not generally serious unless it continues over a considerable period. Local settlement of a part of a unit will develop cracks. If trouble of this character is found, it should be traced to its source. Unless immediate action is required, the size and location of the principal cracks should be recorded so that they can be checked on subsequent inspections.

Should Be Checked

Settlement which causes a complete unit or any part of it to list demands a thorough investigation of its cause. A list about the long axis, that is, movement in overturning, calls for frequent inspection and a careful record of the rate and amount of the movement. This form of failure is dangerous. There is a case on record, of a wing wall 30 years old which was reported one morning to be 2 in. out of line at the top. The next afternoon it rolled over, turning about a construction joint.

Many masonry structures fail through disintegration, for which reason all indications of disintegration should be investigated to determine the cause. This may be external, from weathering, or it may be both external and internal as a result of water coming through the masonry. Likewise, certain types of structures, such as culverts and the pavement on over and under crossings, are particularly affected by erosion. Therefore, one should examine pavements and the flow line of culverts to determine whether this action is taking place.

Careful note should be made to determine whether there is movement at expansion and construction joints. This is particularly important at the joint between a parapet and an arch ring or deck, and between a backwall and a bridge seat. A parapet failure, either by overturning or shoving off, will probably occur suddenly and be complete, making it a decided menace to traffic. Relative movement between a backwall and a bridge seat or between an abutment and a wing wall probably indicates settlement, and should be recorded for future comparison to determine whether it is progressive.

Look for Leaks

One should search for leaks in bridge decks, over the backwall, through construction joints, etc., and for seepage through stone masonry. If any are found, investigation should follow to determine whether the integrity of the structure is being threatened and whether there is any evidence of corrosion in reinforcement. At this time it is also well to check weep holes to insure that they are functioning. Particular note should be made of the position of the fill along the wings and parapets.

Not the least important of the items which should receive attention is the pointing of stone masonry, for which reason all joints should be checked for loose or missing mortar. Displacement of stones as a result of mortar erosion should be among those defects looked for.

Among the foregoing items scour and overturning are the most important. While overturning normally does not occur without ample warning, complete failures may occur suddenly, most likely during the passage of a train. It is for this reason that any indications of scour or overturning should be investigated thoroughly and reported promptly. Most of the other items, while important with respect to maintenance, are not important, at least immediately, with respect to safety.

It will be noted that overloading has not been mentioned. This is a possible, but somewhat rare, cause of failure, because in most cases the safety margin built into substructures has been sufficient to offset the increases in loading which have occurred since they were constructed. On the other hand, there are many small culverts which have scant footings and these may result in settlement under the track to give a saddleback profile which, while unsightly, does not affect the structural soundness of the masonry.

*This discussion was submitted for publication in the What's the Answer department in the December issue as an answer to the question as to what items should be given particular attention when inspecting masonry substructures. Because of its scope, it was withheld for presentation here as an independent article. For further discussion of the subject, see page 801 of the December issue.

What's the Answer?

Regaging when Ballasting

When ballasting follows rail renewal, should the rail be regaged in connecting with the ballasting?

May Be Necessary

By A. E. Perlman
Engineer Maintenance of Way, Denver & Rio Grande Western, Denver, Colo.

No matter how carefully rail may be laid to gage, when the tie plate becomes seated on the tie, variations in the condition of the timber may cause some variation in the seating of the plate which will have an adverse effect on gage. This is true also when the surface is such as to cause some variation in the seating of the plates on the tie. Furthermore, it is possible that respacing of the ties and the squaring up of slued ties may create variations in the gage of sufficient magnitude to make regaging necessary.

Obviously, the problem presented will vary with the condition of the roadbed at the time the rail is being laid. Where out-of-face work is being done, involving renewal of both the rail and the ballast, tie renewals are usually heavy. This, together with the necessary straightening and spacing of the ties and the resurfacing of the track, combine to cause variations in the gage regardless of the care exercised when the rail was laid. In general, therefore, regaging should be done in connection with ballasting which follows rail renewal.

Steel Gang Moves Fast

By Robert White
Extra Foreman, Grand Trunk Western, Pontiac, Mich.

While a high quality of work should be demanded of a rail gang, one must use judgment in balancing quality against production. If the track is not to be given a general raise, it will be desirable to require certain refinements which can be neglected if the ballasting follows closely behind the rail renewal. Since a steel gang moves rapidly, to require these refinements will either reduce production or necessitate a larger force. This does not mean, however, that the care of the rail should be neglected.

Gage is one of these refinements. Tie renewals are likely to be heavy in any track that requires renewal of the rail and ballast. Again, respacing and straightening of slued ties will be a major feature of the surfacing. In any such track it is difficult and sometimes impossible to bring the track to correct gage when the rail is being laid, since an appreciable number of ties will be loose, split, spike cut or partly decayed. Essential features of the work of the ballasting gang are to straighten ties and tie plates, renew defective ties and bring all ties to a solid bearing against the rail, which permit the fullest refinement in gaging.

If Ties Are Slued

By O. H. Carpenter
Roadmaster, Union Pacific, Cheyenne, Wyo.

In general, the gage should not be disturbed at the time of ballasting, following the renewal of the rail, unless there are a sufficient number of slued ties to throw the track out of gage when they are straightened. Any track having slued ties will be out of gage after they are straightened, and it will be necessary to regage the track regardless of whether the rail is new or old. One of the advantages of double-shoulder tie plates is that where they are used the ties do not slue as much as with the single-shoulder design.

Experience has shown that almost invariably some irregularities develop

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in September

1. When rail is released is it practical to match-mark it for laying elsewhere? If not, why? If so, what are the advantages and disadvantages?

2. What are the advantages in eliminating joints in the track across open-deck steel bridges? Timber trestles? Ballast decks? What disadvantages?

3. What is the relative life of joint and intermediate ties? What factors cause this difference? What can the maintenance forces do to equalize the life?

4. Is it practicable to have minor building repairs done by local contractors? If so, under what arrangements? If not, why? What are the advantages? The disadvantages?

5. Where piles are driven to stabalize embankments, should they be tied together? Why? How should this be done?

6. How is the size of the air chamber for a pump determined? Where should it be placed? Why?

7. What means can be employed to eliminate low spots at bridge ends? Does the kind of ballast make any difference? Are construction methods at fault? If so, how?

8. What methods can be employed to pull long steel sheet piling from cofferdams?

after the new rail has been in service for a few months, making it necessary to go over the track at that time to make corrections here and there where they occur.

I prefer to wait three or four months before doing this, to allow the tie plates to become fully seated, rather than to do it immediately after the rail is laid, unless the straightening of the ties affects the gage so much that it must be done while this work is under way.

Gage When Rail Is Laid

By Thor Monrad
Track Supervisor, Northern Pacific. Columbus, Mont.

When ballasting follows rail renewal, regaging should not be necessary when the ballast is applied, provided proper care has been exercised to assure correct gage during the renewal of the rail. Certainly, there can be no dispute that the track should be to correct gage when the rail gang completes its work, or that the rail gang can do the work better and more economically than some following gang which will be required to pull and redrive all spikes, beside having to readjust many of the tie plates. From my point of view, ballasting should be considered a complete job in itself, which should not disturb the rail and fastenings beyond that required to renew ties.

The Answer Is Yes

By G. N. Edmonson
Engineer of Track, New York Central, New York

In general, the answer is positively yes. It is our practice to apply ballast, if such application is necessary, after the rail is laid. Obviously, we gage the rail carefully when it is laid. After that, we space the ties, at which time any regaging that may be necessary is done. At the same time we apply the independent fastenings for the tie plates which assure that the gage will be maintained. If an application of ballast is considered necessary in connection with the respacing of the ties, the new ballast is unloaded after the respacing has been completed. The surfacing then follows, and is completed with the dressing of the ballast section.

Difference of Opinion

By J. Morgan
Supervisor, Central of Georgia, Leeds, Ala.

There are wide differences of opinion and equally wide differences in practice among trackmen on this question. Some believe that more nearly perfect gage results from gaging after the ties are spaced, which is usually required in connection with the rail renewal; others prefer to do the gaging at the time the rail is laid, since it is then unnecessary to repull the spikes.

Either one or both lines of spikes, depending on the width of the base of the new rail compared with that of the old rail, must be pulled when the rail is laid. If they must be pulled again to gage in connection with the ballasting there is duplication of effort, beside which every time a spike is pulled and redriven the tie receives a certain amount of damage which tends to shorten its life. Obviously, however, if the ties are badly slued the gage must be corrected when they are straightened.

When a Pier Settles

When vertical settlement occurs in a masonry pier from overloading of the foundation, what remedy can be applied? How should the work be carried out?

Underpin Foundation

By C. C. Westfall
Engineer of Bridges, Illinois Central, Chicago

In considering this question, it is assumed to refer to a pier in an average railway structure, which does not involve deep foundation work. We have found it both desirable and entirely practicable to increase the area of the foundations in some of our old masonry piers either to remedy settlement that is occurring or to provide for increased loading. In doing so we accommodate the type of work and the methods of construction to the existing foundation. This strengthening has been accomplished by increasing the size of the pier foundation, both with and without the use of foundation piles. Where additional piles have been driven, it has been our practice to carry the reconstruction to the bridge seat; to jacket the pier; and to rebuild the bridge seat to insure a proper distribution of the pier load over the new piles.

In one instance the pier was of cut-stone masonry resting on a floor of 3-in. planks, which in turn, was supported on six rows of piles that were capped with 12-in. by 12-in. timbers. One row of piles was 1 ft. in the clear outside of the pier footing and the other outside row was 2 ft. in the clear. Obviously, the bearing value of these piles was only as much as that of the 3-in. planking upon which the pier was built.

In this case, the plan for strengthening involved the driving of additional piles to balance the foundation, as well as to put the outside rows of old piles to some use. A cofferdam was constructed and unwatered, after which the excavation was carried to a depth of 5 ft. below the old footing. The new piles were then driven and, together with the two rows of old piles, were cut off about 4 ft. below the old pier.

The pier footing was quite narrow and, to insure a satifactory job of underpinning, it was necessary to excavate in sections across the pier and construct a new reinforced concrete footing slab under the entire pier, extending out to catch all of the piles. The concrete was well rammed against the underside of the old grillage timbers and, after 20 years of service under greatly increased loading, this foundation is stable and entirely satisfactory.

In another pier in this same bridge the masonry was not in very good condition and it was desired not only to increase the foundation capacity, but to strengthen the pier shaft as well. To do so, falsework bents on each side of the pin were necessary to carry the ends of the bridge spans on I-beams while the repair work was under way.

A cofferdam was built and additional foundation piles were driven around the old footing, and cut off at an elevation lower than the old footing. The foundation concrete was carried under the grillage timbers a sufficient distance to act somewhat as underpinning for the pier.

An 18-in. concrete jacket was then built to an elevation about 5 ft. below the bridge seat; the top of the old pier was cut away and a new heavily reinforced concrete bridge seat was built across the old pier shaft and the new jacket. The jacket was tied together with 1½-in. rods extending through the pier.

In still another case, a pier having a spread footing began to settle and this trouble was corrected by placing an underpinning entirely around the pier. This underpinning was placed in 4-ft. sections and extended 2 ft. under the pier footing.

These general schemes have been used in several other instances, with such modifications as were necessary to obtain the desired results. These results have been entirely satisfactory and in every instance the work has demonstrated a marked saving, compared with the cost of a complete renewal of the pier.

May Be Serious

By General Bridge Inspector

A settling pier may or may not present a serious problem; in some cases the correction is basically simple; in others engineering ability may be taxed almost to the limit. When a pier begins to settle, whether from overloading or for other reasons, something should be done about it without delay, for delay usually adds to the difficulty of correction as well as to the cost. It should not be overlooked, however, that a basically simple plan is not always easy to execute, since unfavorable conditions may be encountered.

In most cases, the obvious remedy is to underpin the footing in such a way as to give a greater bearing area. If the soil is stable, this can usually be done with relatively little difficulty, although experience has shown that almost every case has special features which demand special treatment. Some of the worst cases in my experience have been stone piers with shallow footings, resting on timber grillages in which decay had gained considerable headway after the ground water had been lowered by drainage projects.

In most cases of underpinning it is wise to extend the concrete in the form of a jacket at least to the ground line. This encasement not only adds to the stability of the addition to the footing, but if properly bonded to the pier shaft, will aid in distributing the load to insure that the underpinning takes its share of the load.

Fading of Repainted Surfaces

What causes parts of repainted wood surfaces to fade more than othars? How can the trouble be remedied?

Variable Absorption

By James J. La Bat
Assistant Foreman Bridges and Buildings, Missouri Pacific, Wynne, Ark.

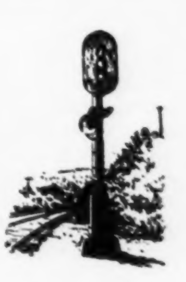
While unequal fading of painted wood surfaces can be traced to several causes, the particular kind of fading which is implied in the question has as its primary cause variations in the absorptive capacity of the surface to which the paint has been applied. This type of fading is characterized by dull and lifeless spots as well as loss of color.

Fading occurs particularly where part of the old paint has been removed and part left on the surface—in other words, where a thorough job of cleaning down to the wood has been done over some areas and not on others where the old paint was adhering satisfactorily. In general, the well-cleaned wood surface will absorb more oil than the area covered by the old paint, robbing the vehicle from the pigment and leaving a lean mixture of oil and pigment.

Spar varnish added to the priming coat will help to seal the pores in the old wood and reduce the amount of oil absorbed from the succeeding coats without reducing the adhesive quality of the priming coat. In general, this will eliminate the spotty areas on the paint surface.

Artificial heat, if of sufficient intensity, and direct sunlight will cause paint to fade, but unless certain areas are shaded this form of fading will be substantially uniform. In other words, the eastern, southern and western sides of a building will fade much more rapidly than the northern side, the paint on the southern exposure being most affected. If unshaded, the rate of fading will be about the same for the whole area of any side but if portions are shaded there may be a marked difference in the amount of fading as compared with the fully exposed areas.

It should not be overlooked that not a few cases of failures from fading can be traced to the use of paint of inferior quality or to application by inexperienced workmen. Paint should be mixed thoroughly before it is applied, whether it is brushed on or applied by spraying. The original cost may be slightly more where the proper care is exercised in this respect, but it will be far cheaper in the long run, and the job will look better during the life of the paint.



Old Paint at Fault

By General Inspector of Buildings

Where fading occurs on a repainted wood surface the trouble can usually be traced to the condition of the old paint. It is the usual practice when cleaning a surface for repainting, to burn and scrape off the paint from those areas where blistering, peeling or cracking are in evidence. The remaining areas, on which the paint is apparently sound and is adhering satisfactorily, are usually brushed to remove the dust from chalking, but are not otherwise treated when they are being prepared for repainting.

These latter areas should be examined thoroughly, for in many cases the paint will be found to have a multitude of very fine cracks which are likely to escape notice except through the most careful observation. In this condition the old paint will absorb fully as much oil as the bare wood in the areas from which the paint has been removed. Despite this, it is not uncommon to apply a priming coat to the areas bared by the removal of the old paint, but not to those on which the old paint remains.

In doing this, the absorptive demand of the wood has been satisfied by the oil in the priming coat but the old paint, being as porous as the wood itself, will absorb enough oil from the first and second repainting coats to satisfy its demand for oil, leaving the pigment in the new paint with a deficiency of oil. Where this occurs the areas represented by the old paint will appear lighter than those which were given a priming coat. This is not a gradual process over the life of the paint, because a marked difference in shade develops quickly, although the fading will continue to grow worse for some time.

Where these conditions are encountered, two courses are open in the first instance. The first is to extend the priming coat to cover the entire surface, including the old paint. The other is to burn off all of the paint and start the repainting with the bare wood. If the decision is to use a primer on the old paint it should include sufficient turpentine to insure thorough penetration.

If these precautions have not been taken and the paint shows signs of

fading, two courses will be open. If the old paint is properly anchored, and shows no signs of loosening, the faded areas can be given a third coat of the same mixture that was used as the finishing coat, which should be thoroughly brushed in. If the old paint shows a tendency to loosen, the proper procedure, if it is desired to do a first-class job, will be to burn all of the paint from the affected areas and repaint from the bare wood.

Sodding Cuts and Embankments

What methods can be employed to induce the growth of grass on slopes of cuts and embankments? What varieties of grass are best suited for this purpose?

Use Native Grasses

By Division Engineer

Among the essentials of providing a good stand of grass on the slope of a cut or embankment are a smooth surface, a slope that is not too steep and soils which will support the grass. Obviously an embankment constructed of stone, slate, shale, etc., or a cut in which these materials outcrop will be unsuited for growing grass. Most grasses do not grow well on compact clays, for which reason if the exposed strata are not suited for growing a thick crop of grass, several inches of rich top soil should be applied to the surface to insure a quick and heavy growth.

Since a smooth surface is desirable, an intercepting ditch should be constructed on the uphill side of the cut to divert surface drainage and thus prevent gullying of the slope. Generally speaking, the steeper the slope the more difficult it is to maintain a good stand of grass; some soils are inclined to slough from steep slopes when the frost goes out and spring rains are abundant. For this reason, it is desirable that the slope shall not be steeper than 1½:1, and flatter if practicable.

After the surface has been made smooth, several inches of rich top soil should be spread evenly and a heavy application of grass seed made, after which it is desirable to compact it slightly by means of a light roller. Wherever possible, native grasses should be employed, for they are inured to the climate and soil and usually give better results than imported grasses. It is also better to use a mixture than to rely on a single species, except where Bermuda grass or similar types are used.

It is not always feasible to dress a slope and sow the grass seed. I recall an instance of a long high embankment on a new line in the West, which had been constructed of loose, sandy but rich soil, that eroded so badly that we were unable to get vegetation to grow on it. Finally we stopped trains of stock cars and cleaned them at this point until we had a cover about six inches deep. This stopped the wash and the material from the cars contained so much grain and weed seed that we obtained a growth of vegetation very quickly, although it was several years before we were able to get rid of the weeds and obtain a good stand of grass. On another embankment of similar material in the South, which was higher and longer, slips of Bermuda grass planted in staggered rows 18 in. apart soon provided a compact sod.

Applies Top Soil

By Robert Faries
Assistant Chief Engineer—Maintenance, Pennsylvania, Philadelphia, Pa.

In cuts where the adjacent ground is level or pitches toward the slope, an adequate berm ditch is provided along the top of the slope to carry off storm water and keep it from getting on the slope, thus preventing erosion and slides. The slope is graded to a uniform surface, eliminating any pockets where water might collect and filling up small washes and other surface erosions. For ordinary subsoils which are fairly stable, the slope should be not less than 1½:1, and where slopes are of soft unstable material or material which runs easily when wet, the slope should be made 2:1, if practicable.

The surface of the slope is then covered to a depth of approximately 3 in. with growth-promoting top soil. Where mushroom soil—waste from the plants of commercial mushroom growers—is available, it is used. This material will promote growth more quickly and of greater density than ordinary top soils. It is easy to handle and apply uniformly and generally contains a quantity of weed seeds which come up quickly and assist in providing vegetation on the slope, until grass has an opportunity to obtain a foothold.

On slopes which are composed largely of sand, an undercovering of soil containing a considerable amount of clay is applied to a depth of about 3 in., to act as a stabilizer and foundation for supporting the growth of vegetation, before the mushroom soil is applied.

Immediately after applying the mushroom or other top soil, grass seed is sown, using 130 lb. of seed to the acre. This is a mixture composed of coarse grass seeds, by weight as follows: Canadian blue grass, 20 per cent, New Zealand fescue, 10 per cent; red top, 20 per cent; white clover, 10 per cent; perennial rye, 30 per cent; and orchard grass, 10 per cent.

Unloading Ties with System Gangs

What advantages, if any, are there in distributing ties by special gangs on a system or regional basis? When should they start?

Approves It

By O. H. Carpenter
Roadmaster, Union Pacific, Cheyenne, Wyo.

Experience has shown that the advantages of unloading ties with special gangs using work trains far outweigh any disadvantages. One of the first considerations in unloading ties is the safety factor, since this operation has always been one of the prolific sources of personal injury. By using a single gang to do the unloading for a large territory, both the men and the foreman become proficient in the work. As a result, they not only do the work more safely, but they unload more ties per man per day, once they become accustomed to the work. We have developed a special tie tong which is very effective and safe for unloading ties from open-top cars.

By using a special gang, the ties can be unloaded at the point of use directly from the cars in which they were loaded at the treating plant. If the tie program has been worked out well by the roadmaster, he will know how many ties to unload per mile, and on certain fractions of the mile, so that the minimum of trucking will be

where the ties cannot be unloaded from work trains.

A gang foreman and 20 men, using 18 men in the cars to unload, with one man counting the ties as they are unloaded and one to assist the foreman to watch for obstructions, such as relay boxes, signals and roadway signs, will unload 10,000 ties during an 8-hr. day. This brings the cost for unloading well under two cents a tie, which is cheaper than by any other method with which I am familiar.

Where ties are unloaded at stations and later trucked to destination as needed, considerable time is required to do this at a time when the gang has plenty of other pressing work on hand. If the ties are distributed during the winter the handling of the ties will not interfere with other work during the busy season. Another important objection to trucking is the faster schedules of all trains and the consequent delays to trucking movements by reason of waiting for trains and clearing them earlier than was formerly considered necessary. Again, the light section motor cars which are replacing the heavier models are not as suitable for pulling heavy loads.

Only two objections can be raised to the system distribution; some ties will be unloaded long before they are used and allowed to lay scattered along the track, and if not installed until late in the summer they may be subject to danger from grass fires. Both of these objections can be overcome by installing the ties as early as weather permits, which is the proper time from every other maintenance viewpoint anyhow.

Distribution of the ties should be started in time to complete the unloading on all of the territory which any gang is scheduled to cover by the time it is desired to start tie renewals. This time will depend on the extent of the territory and the number of ties to be unloaded.

Can Be Done at Less Cost

By R. W. Lucas
Track Supervisor, Chicago, Rock Island & Pacific, Enid, Okla.

If not properly done, tie distribution is quite expensive, for which reason it should be given more consideration than it usually receives. I believe that ties should be distributed by special gangs out on the line but not in yards. Such gangs will soon be trained in this particular class of work and as they become familiar with the work the number of personal injuries will be reduced, if not eliminated. It is easier to train a single gang, or even two or three, to handle treated ties safely and effectively from moving cars, than to train every gang on the system, particularly as the former will work continuously for weeks, while the individual gangs will complete their distribution in a day or two, and thus get no real training in safety.

When a gang is organized for this service, experienced trackmen should be selected who are physically able to handle the ties. The shipments should be arranged so that they will be on hand at the appointed places on the line according to the tie requirements for the season, and far enough in advance of the arrival of the gang to insure that there will be no delays caused by non-arrival of shipments.

Since it is desirable not to have the ties distributed too far in advance of use, the schedule for unloading should be given thorough consideration. In general, this should be left to the judgment of the maintenance officer on the district, with the understanding that the unloading will be done shortly before application.

Power Tools in Bridge Repairs

What power tools can be used to advantage in the repair of timber bridges? For what operations is each best adapted?

Affected by Many Factors

By Frank H. Cramer
Assistant Bridge Engineer, Chicago, Burlington & Quincy, Chicago

In the use of power tools in the maintenance of timber bridges, much depends on the kind and magnitude of the repairs that are to be made. If only a short bridge is involved, the amount of repair work will normally be small and usually light in character. In this event it will probably not be economical to use power tools if they are of the type that requires an independent power plant for their operation. At the other extreme, if the bridge is long and high, and particularly if the repairs are heavy and large in volume, almost any power equipment adapted for timber construction can be used to advantage.

When selecting power tools, a general survey of the structures on the system should be made for the purpose of classifying the work to be done into light and heavy repairs, at the same time recording the volume required in each class. For the light repairs a small gasoline or electric unit with a power drill, a power hand saw and a power lag-screw driver, will be the most useful equipment. The use of these tools is confined largely to work on the deck of the structure.

Larger outfits will be required where the repairs are heavy, particularly if the volume of work is large, including the renewal of piles, the replacement of piles with timber posts, the renewal of caps and the larger sizes of stringers, and the extensive replacement or application of bracing. This outfit should include the necessary power units and tools for boring holes in fender timbers for bolts or drift bolts, in bracing and in piles or posts and caps for bracing, in stringers for drift bolts and also for line spikes and wood screws. It should also include power hand saws for cutting fender timbers, sway braces, bulkhead timbers and, if necessary, stringers. The larger timbers can be cut by sawing into one side of the timber as far as the saw will penetrate and then turning the timber over and making a companion cut from the other side. In most cases, a valuable tool is that for driving lag screws. If pneumatic tools are used, the outfit should include one for driving drift bolts; and a saw for cutting off pile heads should be a part of the equipment with every outfit.

Generating units should have sufficient capacity to handle all of the power tools required on the job and, in addition, to provide light for emergency work at night. Air compressors and pneumatic tools are somewhat more expensive as to first cost and are somewhat heavier to handle than those driven by electricity. Despite this, they will perform the same work and, except for lighting, are as effective as the electric outfits. Where gangs are supplied with compressor outfits for purposes other than the repair of timber bridges, it will pay to equip them with tools suitable for making these repairs and particularly to enable them to perform emergency

work more rapidly and effectively.

In considering this matter it should not be overlooked that the growing practice of preboring and preframing bridge timbers and the elimination of drift bolts in timber-bridge construction are placing some restrictions on the use of power tools in the construction and renewal of timber bridges. Yet they can be used to advantage in repair work. In fact, the field for these tools is wider than that of bridge repairs, for they are adapted particularly for use on docks, wharves, piers, river and lake protection, and bulkheads of various kinds and in the construction of falsework, to mention only a few of their applications.

Finds Many Uses

By Carl Kohler
Supervisor of Bridges, Erie, Cleveland, Ohio

Following the development of power tools for steel bridges, many corresponding devices have appeared for use in timber construction. Among those which are most useful are retainer-equipped guns for operating chisels to smooth off irregular rock seats for timber-bent footings; air hoists; power hand saws, these being particularly valuable for cutting gains and tenons; special gouges for cleaning out gains after sawing; power borers and power wrenches, particularly those of the impact type. The latter tool is especially valuable for removing lag screws and nuts, both of which usually give much trouble because they are frozen by corrosion. The hammer blow afforded by the impact device loosens both nuts and lag screws, which are otherwise difficult to start. It should be pointed out that the special gouges for cleaning gains are not being manufactured commercially. Those we have used have been fashioned in the field, but we have found them to be very useful.

While the reduction in labor made possible by these devices is attractive, their principal advantage lies in the reduction in the time required to perform the various classes of work for which they are adapted. This results in shortening the time required for the repairing of individual structures.

Volume Deciding Factor

By Assistant Engineer of Maintenance

While power tools can be used to advantage in the repair of many timber bridges, quoting from a comment on a related question which appeared on page 471 of the May, 1931, issue, "Generally, there are only a few bridges on a foreman's district which require heavy maintenance, the remainder requiring little, if any, work for which power tools are adapted * * * * Handling and placing the timber often consume more time than its preparation, so that the power equipment is not kept working long enough to earn its carrying charges." For these reasons, the term "used to advantage" must be considered in a broad economic sense.

In arriving at the answer to the question under consideration, thought must be given to the magnitude and nature of the work to be done at the various points on a district. The size of the power unit and the effort required to transport and set it up must be considered, as well as transmitting the power to the tools.

Obviously, if the job is large, more time can be justified for transporting, assembling and disassembling the unit and the transmission lines. Conversely, if the job is small, even a small cost for these items may not be warranted. In fact, a very large percentage of the total repairs is made up of items that are so small that the use of power tools on them cannot be justified.

For the usual run of timber bridge repair jobs, a chain-link saw, a circular saw which will cut at least four inches and two drills can be used to advantage, provided the power unit can be handled easily by four men, and provided further that the power transmission lines can be laid down and taken up readily. On the larger jobs bolters and lag-screw drivers can be used in addition, but they have the effect of increasing the power and transmission demands.

Tamping with Ballast Forks

Is it practicable to tamp with ballast forks? If so, what is the minimum lift? If not, why? Does the kind of ballast make any difference?

Only on High Lifts

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

That track ballasted with crushed stone or slag can be tamped with forks is conceded; that a reasonably good job of surfacing can be done in this way is also conceded. But where this method of tamping is practiced, the track must be given a relatively high lift, say three inches or more, to make this form of tamping practicable. On a line which has an insufficient amount of ballast and the ballast is being applied to provide a greater depth under the ties, there is an advantage in tamping the first and second lifts with forks, but the finishing lift of 1½ to 2 in. should be done with picks or preferably with mechanical tampers, after the previous tampings have become consolidated.

On a high lift there is little consolidation of the ballast from tamping, regardless of the method. For this reason, fork tamping is as effective as pick tamping, since the ballast must be consolidated by traffic. As the fork tamping can be done so much more rapidly, it has much to commend it.

Today few important lines suffer from insufficient ballast under the ties. They are more likely to be afflicted with dirty ballast, center-bound track or "dead" track. The cleaning of the ballast is usually followed by general surfacing and this is the only remedy for the other two defects mentioned. In general, however, a raise of about two inches is sufficient in all of these cases, which is not enough to permit tamping with ballast forks.

Is a Regular Practice

By M. Donahoe
Division Engineer, Alton, Bloomington, Ill.

On the Alton, the tamping of stone ballast with ballast forks that are designed for this service as well as for cleaning ballast, where the track is given a lift of three inches or more has been a regular practice for several years, and has proved satisfactory. Tamping with forks can be done about as uniformly as with picks if the ballast is not too coarse, that is, not larger than 2½ in.

Our ballast forks have 10 tines spaced ¾ in. apart; they are 14 in. long and the overall width is 9½ in. The tines are curved specifically for tamping, but they can be used with the same facility for cleaning ballast as other designs. A given number of men are able to tamp about 60 per cent more track with forks than with tamping picks, or about the same amount that can be tamped with shovels when working in fine ballast such as gravel.

After a few days of settlement, track that has been raised 3 or 4 in., or even more, and tamped with forks, may require pick tamping when low spots develop. This is no different, however, from what might be expected from a similar lift tamped with picks.

It Is Practicable

By W. H. Brameld
Assistant to Chief Engineer Maintenance of Way, Erie, Cleveland, Ohio

It is practicable to tamp with ballast forks where the track is raised three inches or more on stone or crushed-slag ballast. A better job can be secured with tamping forks than with the ordinary ballast fork. We use a special fork for tamping which is narrower, but has heavier and stronger tines and less lift than the ordinary ballast fork. Our practice in ballasting is to do the tamping with the forks, provided the raise is not less than three inches, and allow traffic to compact it during the winter. The following season we make a raise of 1½ to 2 in. and tamp with pneumatic tampers. We have followed this practice for five or six years with very satisfactory results.

Does Not Approve

By Thor Monrad
Track Supervisor, Northern Pacific, Columbus, Mont.

Ballast forks should never be allowed to be used for tamping, at least those with which I am familiar. These forks have sharply pointed tines which form a personal-injury hazard when used in tamping service, while the very sharpness of the tines makes the tool unsuited for tamping, since this work should be done with a tool having a blunt end. This applies to all kinds of ballast and to lifts of any height. My opposition is also based on the principle that it is poor practice to use hand tools for purposes for which they were not designed. The ballast fork was designed for cleaning and dressing ballast and not for tamping or any other purpose.

Better Than Shovels

By L. A. Rape
Extra Gang Foreman, Baltimore & Ohio, Wampum, Pa.

Ballast forks can be used to real advantage for tamping in stone or slag ballast, but are useless if the ballast is cinders, gravel or other fine material One can do a better job with them than with shovels, for large pieces of ballast sometimes lodge between the edge of the tie and the bed, which must be picked out if shovels are used. These pieces can generally be dislodged with ease by the fork, or the tines may spread enough to straddle them, making them, in effect, no obstruction to the work.

Forks cannot be used for spot or other light surfacing since a raise of at least two inches is necessary for this form of tamping, and may be more, depending on the size of the ballast. Where a sufficient lift is made a good job of tamping is possible, and the work can be done much faster than by any other method.

Adjusting Deep-Well Pumps

How long should the stroke of a deep-well pump be? What determines this? How does one adjust the length?

Depends on Demand

By Water Service Inspector

A few years ago practically all reciprocating deep-well pumps were of the variable-stroke type and many of these older designs are still in service. As the water-supply facilities have been rebuilt or enlarged in recent years, however, many of these pumps have been replaced with modern designs which have no provision for varying the stroke, or with some form of centrifugal pump.

This type of pump is usually driven by motors or internal combustion engines, the speed of which is practically constant. To allow some latitude in production for the well, where the speed of the power unit is constant, it becomes necessary to provide for variation in the length of the stroke. The primary consideration in determining the length of stroke to be used is the amount of water that must be pumped in a given time.

A deep-well pump will have a longer life and require less maintenance if it is operated at slow speed on a long stroke. This may not be sufficient to meet the demand or to develop the capacity of the well, since maximum production is obtained by lowering the water in the well to permit increased inflow from the water-bearing strata. It may be better, therefore, to operate at higher speed on a short stroke.

Length Governs Capacity

By Water Service Supervisor

Today, pumps are selected on the basis of their ability to meet the conditions imposed by the nature of the supply, the character of the plant and the volume of consumption. This was not always so, for the older designs of deep-well pumps were provided with a variable stroke for the purpose of adapting them for as wide a range of conditions as practicable. Despite the advances in pump design, many of these older adjustable pumps are still in use and are giving service.

Obviously, the length of the stroke and the speed of operation are related intimately; that is, the longer the stroke the slower the speed must be. It is impracticable to say dogmatically what the stroke should be, for this will depend on several variable factors, including the size of the pump, the capacity of the power unit, the capacity and rate of production of the well, the head against which the pumping must be done, the demand for water, and whether the pump is double or sinble acting.

Non-stop Train on the London, Midland & Scottish Between Enston, England, and Glasgow, Scotland, 401½ Miles in 5 Hr. 44 Min.

News of the Month

Status of Grade Crossing Program

As of April 30, a total of $68,217,103 of federal works progress funds had been spent on completed grade crossing projects, including 987 new grade separations, 171 reconstructed separations and 144 crossings protected by signals or otherwise. On the same date a total of $95,689,-928 had been apportioned to work under construction, including 797 new separations, 138 reconstructed separations, and 345 protection projects. Approved for construction, with apportionments totaling $13,381,125, were 119 new separations, 23 reconstructed separations and 397 protection projects.

Black-Connery Bill Opposed by Rail Employees

Railroad employees, through the Railway Labor Executives Association, have expressed their opposition to the Black-Connery bill fixing minimum wages and maximum hours of employees in industry. This sentiment became manifest on June 7, when the Railway Labor Executives Association met at Chicago and adopted a recommendation that the bill be amended to exclude railway labor. As a result, the association will appear before the Black-Connery committee in support of an amendment that will, if adopted, exclude all employees governed by Section 1 of the Railway Labor Act.

Freight-Rate Structure Criticized

Criticism of the country's freight-rate structure was voiced in a report which was recently prepared by an economist of the Tennessee Valley Authority and submitted to Congress on June 7 by President Roosevelt. Declaring that the present freight rate structures were arbitrary barriers to commerce, competition and widespread industrial development, and that the country as a whole has no national freight-rate structure, the report pointed out that rates in the Eastern or Official territory were far less than those in other sections of the country. With the average of freight rates in the East assumed as equalling 100, the Southern rates were found to average 139, the Western Trunk line rates, 147, Southwestern rates 175, and Mountain Pacific rates 171. Because of this situation, the report said, manufacturers and producers in other than Eastern territory are at a disadvantage because of the lower rates available to competitors in Eastern territory where the largest markets exist. To solve this rate problem the report advocates either voluntary action by the carriers, administrative procedure of the Interstate Commerce Commission or the necessary legislation.

New Retirement Bill Signed by President

The new railroad retirement bill, having been passed by both houses of Congress, became a law on June 24 when it was signed by President Roosevelt. This bill embodies provisions that were adopted in conferences between representatives of railroad employees and the managements and will replace a bill which was declared unconstitutional by the Supreme court. An excise tax measure providing for the collection of funds to finance the retirement bill is now on its way through Congress, having been passed by the House of Representatives on June 24.

Railroads Active in Reducing Air Pollution

Railroads entering large cities have reduced to a minimum that fraction of total air pollution attributable to locomotives, according to comments made at the 1937 convention of the National Smoke Prevention Association in New York. During this meeting statistics were cited to show that the truck line railroads terminating on the New Jersey shore opposite New York City have reduced locomotive smoke from 23.5 per cent of the total pollution in 1931 to 1.24 per cent in 1937. Papers presented by railroad men described the smoke prevention activities in which railroads are now engaged.

Harriman Safety Awards

Representatives of three railroads were awarded Harriman memorial medals for the best safety performance in their respective groups in 1936, at a luncheon of the American Museum of Safety at New York on June 23. For winning first place in Group A (over 10 millon locomotive-miles annually) the Chicago & North Western was awarded a gold metal which was received on behalf of the carrier by Fred W. Sargant, president. The recipient of the silver medal, which is awarded to the railroad holding first place in group B (1,000,000 to 10,000,000 locomotive-miles), was the Detroit, Toledo & Ironton, while the bronze medal, which goes to the carrier holding first place in group C (under 1,000,000 locomotive-miles) was awarded to the Lake Superior & Ishpeming. The awards were made by the museum on behalf of W. A. Harriman and E. R. Harriman, sons of the late E. H. Harriman, in whose memory the awards were instituted 24 years ago by Mrs. E. H. Harriman.

Railroads Big Consumers of Water

Approximately 600,000,000,000 gallons of water are consumed annually by the railroad systems of this country, according to figures compiled by the Association of American Railroads. This quantity of water, says the A.A.R., would be sufficient to fill a channel 100 yd. wide and 9 ft. deep, extending from New York to San Francisco, Calif., and return. If spread over the ground to a depth of one foot and frozen it would provide a skating rink nearly 54 miles square.

Railroad Exhibits for 1939 World's Fair

Activities directed towards the creation of a railroad exhibit at the New York World's Fair in 1939 were initiated recently when the Eastern Presidents' Conference appointed a committee to give consideration to the matter. This committee, which consists of J. M. Davis, president, Delaware, Lackawanna & Western; F. E. Williamson, president, New York Central; G. LeBoutillier, vice-president, Pennsylvania; Daniel Willard, president, Baltimore & Ohio; and H. S. Palmer, trustee, New York, New Haven & Hartford, has appointed a subcommittee to make a study and to present recommendations. An early decision as to the extent and details of the railroad's exhibit must be made in order that adequate space may be allotted and construction contracts awarded in time to insure completion of the necessary buildings.

Engines Must Have Power Reverse Gears

All steam locomotives built after September 1, 1937, must be equipped with power reverse gear, according to an order issued by the Interstate Commerce Commission on June 14, in which it was held that the use on steam locomotives of manually-operated reverse gear "causes unnecessary peril to life and limb and that the safety of employees and travelers requires that suitable power-operated reverse gear shall be substituted for manually-operated reverse gear." In addition to stipulating that all steam locomotives built after September 1 shall be equipped with power reverse gear the order specifies that all steam locomotives used in road service built prior to September 1, which weigh on the driving wheels 150,-000 lb. or more, and all steam locomotives used in switching service built prior to September 1, which weigh on the driving wheels 130,000 lb. or more, shall have a suitable type of power-operated reverse gear applied the first time after September 1 that these locomotives are given repairs defined by the United States Railroad Administration as Class 3 or heavier.

Association News

Bridge and Building Association

President E. C. Neville has called a meeting of the Executive committee in Chicago on July 24 to review the reports of the committees and to complete plans for the forty-fourth annual convention which will be held at the Hotel Stevens, Chicago, on October 19-21.

Roadmasters Association

President B. E. Haley has called a meeting of the Executive committee at the Hotel Stevens, Chicago, on July 10. At this meeting plans will be completed for the fifty-second annual convention which will be held at the Hotel Stevens on September 14-16. Reports will also be received at this meeting from the special committee appointed to stimulate increased membership in the association.

American Railway Engineering Association

The proceedings of the 38th annual convention, which was held on March 16-18, inclusive, are now on the press and it is anticipated that they will be mailed to the members early in July, thereby completing the work on them from 30 to 60 days sooner than has usually been the case in the past.

In addition to the meeting of the Board of Direction at Toronto on June 25, meetings were held by seven committees during the past month. These were as follows: Masonry, at Urbana, Ill., on June 1; Water Service, Fire Protection and Sanitation, at Buffalo, N.Y., on June 9 and 10; Ties, at Boston and New York, on June 15 and 16; Records and Accounts, at New York, on June 24; Economics of Railway Operation, at Montreal, on June 24; Wood Bridges and Trestles, at Chicago, on June 25; and Grade Crossings, at Chicago, on June 29. Meetings scheduled for July include those of the following committees: Yards and Terminals, at Syracuse, N.Y., on July 12; Buildings, at Boston, Mass., on July 13 and 14; Iron and Steel Structures, at Detroit, Mich., on July 15 and 16; and Waterways and Harbors, at Chicago, on July 20.

Metropolitan Track Supervisors' Club

The annual outing and final meeting of the club for the season was held at the Houvenkopf Country Club, Suffern, N.Y., on June 10. Ninety members and guests were in attendance. After a morning of golf and a program of field events, there was a buffet luncheon, which was followed by a business session, the most important feature of which was the election of officers for the next fiscal year. The results of the election were as follows: President, J. R. MacAsy, supervisor of track, Erie; first vice-president, J. Ensign, assistant division engineer, New York Central; second vice-president, T. F. Langan, supervisor of track, Delaware, Lackawanna & Western; secretary-treasurer, G. M. Cooper, Ramapo Ajax Corporation (re-elected). Members elected to the executive committee were, Mr. MacAsy, (the new president); I. D. Talmadge roadmaster, New York, Ontario & Western, (the retiring president); Oscar Surprenant, roadmaster, Delaware & Hudson; John Reardon, supervisor of track, New York, New Haven & Hartford; and W. E. Bugbee, Eastern Railway Supplies.

Wood Preservers' Association

Approximately 30 members of the association, including the members of the Executive committee, met at the Forest Products Laboratory, Madison, Wis., on June 10. The Executive committee was in session most of the day, while other members visited the work in progress at the laboratory. The Executive committee will hold its next meeting in Chicago in October.

The Congress Hotel has been selected as the headquarters for the next annual convention, which will be held in Chicago on January 25-27, 1938.

Rust Inhibitor—The Truscon Laboratories, Detroit, Mich., have issued a four-page illustrated bulletin, known as Form No. 441, which is devoted to this company's rust inhibitor, Bar-Ox formula 97. The bulletin describes this product and tells how it acts to prevent the rusting of steel surfaces to which it is applied.

Transite Roofing and Siding—Cutting maintenance costs on industrial roofing and siding is the main theme of a 12-page brochure issued by Johns-Manville, New York, which features J-M corrugated Transite, pointing out its advantages and general adaptability. The brochure also describes the erection of corrugated Transite and includes a page of construction details.

Self-Locking Bolts and Nuts—The Dardelet Threadlock Corporation, New York, has issued a four-page bulletin, No. 16, which describes and illustrates the features of Dardelet self-locking bolts and nuts, how they function, and what they accomplish. In addition, the bulletin discusses the wide application of Dardelet bolts and nuts and includes considerable engineering and test data.

Motorpumps—The Ingersoll-Rand Company, New York, has issued a 16-page catalog describing its complete line of Cameron motorpumps. These pumps, which are compact machines combining electric motor and centrifugal pump in a single unit, and which are furnished in capacities ranging from 5 to 1,000 gal. per min. for heads up to 500 ft., are fully illustrated in the catalog, both as applied to various services and sectionally to show their construction. The catalog also includes detailed tabular matter with regard to the sizes of pumps available and their adaptability to various working conditions that are encountered.

Personal Mention

General

R. H. Carter, supervisor of track on the Chicago terminal of the Illinois Central, has been promoted to assistant general yardmaster in charge of switch tenders and crossing flagmen, with the same headquarters.

W. R. Gillam, district engineer of the Southern lines of the Illinois Central, with headquarters at New Orleans, La., has been appointed superintendent of the Iowa division with headquarters at Waterloo, Iowa, to succeed **Walter S. Williams,** deceased. A biographical sketch and photograph of Mr. Gillam were presented in the March, 1937, issue of *Railway Engineering and Maintenance* on the occasion of his appointment as district engineer.

C. K. Scott, who was formerly connected with the engineering department of the Erie, has been appointed superintendent of the Marion division of this company at Huntington, Ind. Mr. Scott has been in the service of this company for 24 years. He was born in 1889 at Kent, Ohio, and first entered railway service in 1913 with the Erie as a transitman in the engineering department at Huntington, being appointed assistant engineer at Cleveland, Ohio, in the following year and section foreman at Huntington in 1915. Subsequently he was promoted to track supervisor with headquarters at North Judson, Ind., and then assistant division engineer at Meadville, Pa. Eventually Mr. Scott was promoted to division engineer, serving in this capacity at Marion, Ohio, and Youngstown. Next he was made trainmaster, which position he held at Scranton, Pa., and Attica, New York. For a time he served as assistant to the general manager at Jersey City, N.J., then returning to the position of trainmaster, in which capacity he served successively at Paterson, N.J., Kent, Ohio, and Youngstown. He was located at the latter point at the time of his recent appointment.

C. K. Scott

Engineering

Richard I. Gloster, office engineer of the Western Pacific, has also assumed the duties of valuation engineer, to succeed **C. H. Byers,** deceased. Mr. Gloster's office is at San Franicsco, Cal.

M. W. Beach, assistant district engineer of the Northern Pacific, has been appointed acting engineer of bridges, with headquarters at St. Paul, Minn., to succeed **M. F. Clements,** whose death is noted elsewhere in these columns.

E. C. Morrison, who has been engaged on special duties in the engineering department of the Southern Pacific, has been appointed acting division engineer at Los Angeles, Calif., to succeed **G. W. Corrigan,** who is on a leave of absence because of ill health.

J. M. Miller has been appointed division engineer of the Elkins division of the Western Maryland, with headquarters at Cumberland, Md., succeeding **Rex Hoop,** who has been assigned to other duties, on account of physical disability.

Mr. Miller has been in the service of the Western Maryland for about 19 years. He was born on June 25, 1900, at Sabillasville, Md., and after a public school education he obtained private instruction in civil engineering. He entered railway service with the Western Maryland on

J. M. Miller

June 25, 1918, in the transportation department at Hagerstown, Md. In September, 1923, he was transferred to the engineering department as a rodman and later held the positions of levelman, draftsman and instrumentman. On August 16, 1932, he was appointed supervisor of track with headquarters at Hanover, Pa., being transferred to Westminster, Md., on June 1, 1934. On April 1 of this year he was further promoted to assistant division engineer of the Elkins division, with headquarters at Cumberland, Md. His further promotion to division engineer of the same division became effective on June 16.

E. J. Cullen, division engineer of the Lehigh Valley, with headquarters at Buffalo, N.Y., has been promoted to chief engineer, with headquarters at Bethlehem, Pa., succeeding **G. T. Hand,** who has been appointed consulting engineer. **J. F. Donovan,** division engineer, with headquarters at Wilkes-Barre, Pa., has been transferred to Buffalo, N.Y., succeeding Mr. Cullen and **C. P. Terhune,** assistant engineer at Easton, Pa., has been promoted to division engineer at Wilkes-Barre to relieve Mr. Donovan.

Mr. Cullen was born at Jersey City, N. J., on March 12, 1891, and entered railroad service in 1907 as a clerk on the Erie. He entered the service of the Lehigh Valley in 1912 as an extra gang foreman, and after holding various positions and serving as a levelman, transitman and supervisor of track, he was promoted to division engineer at Auburn, N.Y., in 1920. In 1926 he was transferred to Sayre, Pa., as division engineer of what was then the Seneca division. In March, 1927, he was transferred to the Buffalo division as division engineer, and in 1932 when the Seneca and the Auburn divisions were merged with the Buffalo division, Mr. Cullen was appointed division engineer of the enlarged division, which position he has held until his recent promotion.

Mr. Hand was born in Elizabeth, N.J., and began railway work in 1889 as a rodman on the National Docks Railway, now a part of the Lehigh Valley. He was principal assistant engineer of the same road from 1895 to 1900 in charge of the construction of the railroad, docks and warehouses, including the present terminal of the Lehigh Valley at National Docks, Jersey City. Mr. Hand went with the Delaware, Lackawanna & Western in 1900 as assistant engineer. His work in this capacity consisted primarily of laying out and reconstructing the Hoboken passenger and freight terminals. In 1909 he was appointed terminal engineer of the Lackawanna in charge of the maintenance and construction of buildings, docks, and bridges. From 1911 to 1917 he was division engineer of the Morris and Essex division in charge of maintenance and construction of buildings. Mr. Hand was appointed chief engineer of the Lehigh Valley on May 1, 1917, with headquarters in New York City. In addition to his official railway connections he has served in a consulting capacity on many large and important projects in this country and abroad.

Mr. Terhune, the new division engineer at Wilkes Barre, was born on January 22, 1889, at Newark, N.J., and received his higher education at Cooper Union College, from which he was graduated in 1909. He entered railway service in the fall of 1909, as yard clerk on the Pennsylvania, and later was transferred to the engineering corps of that road, engaged in the construction of its Hudson River tubes at New York. On December 12, 1912, he left the Pennsylvania to become a levelman on the Lehigh Valley, and on March 7, 1913, he was promoted to draftsman, with headquarters at Easton, Pa. In 1916, he was promoted to transitman, which position he held until 1919, when he was promoted to assistant division engineer, with headquarters at Easton. He was holding this position at the time of his recent promotion to division engineer at Wilkes Barre.

C. M. Chumley, division engineer of the Kentucky division of the Illinois Central, with headquarters at Paduach, Ky., has been promoted to district engineer of the Southern lines at New Orleans, La., to succeed **W. R. Gillam,** who has been appointed superintendent, as noted elsewhere in these columns. **S. C. Jump,** supervisor of track with headquarters at Clinton, Ill., has been promoted to division engineer of the Vicksburg division, with headquarters at Vicksburg, Miss., to succeed **C. J. Carney,** who has been transferred to the Kentucky division, to replace Mr. Chumley.

Mr. Chumley has been in the service of the Illinois Central for 34 years. He was born on May 21, 1882, at Union City, Tenn., and first entered railway service on March 16, 1903, in the bridge and build-

C. M. Chumley

ing department of the Yazoo & Mississippi Valley (part of the Illinois Central System), at aBton Rouge, La. From February, 1905, to September, 1906, he served as a clerk and storekeeper at Harriston, Miss., then being appointed bridge and building foreman on the New Orleans division of the Y. & M. V. In October, 1907, Mr. Chumley was promoted to general foreman in the bridge and building department of the same division, which position he held until December, 1909, when he was made supervisor of bridges and buildings of the Memphis division of the Y. & M. V., with headquarters at Memphis, Tenn. On May 1, 1920, he was promoted to division engineer of the Mississippi division of the Illinois Central, with headquarters at Water Valley, Miss., being transferred to the Louisiana division on June 1, 1921, with headquarters at McComb, Miss. On September 23, 1931, Mr. Chumley was transferred to the Kentucky division with headquarters at Paducah, Ky., where he was located at the time of his recent advancement to district engineer at New Orleans.

Track

George Talbot, acting roadmaster on the Canadian Pacific, with headquarters at Red Deer, Alta., has been appointed roadmaster at the same point, to succeed **P. Gordon,** who has retired. The appointment of Mr. Talbot as acting roadmaster at Red Deer was reported in the April issue of *Railway Engineering and Main-*

tenance. **O. Totland,** section foreman at Lanigan, Sask., has been appointed acting roadmaster, with headquarters at Wilkie, Sask., to replace **J. A. Sewell,** who has been granted a leave of absence from June 15 until October 31.

T. W. Kendall has been appointed roadmaster on the St. Louis-San Francisco, with headquarters at Springfield, Mo., to succeed **J. H. Weed,** who has retired.

W. C. Lowe has been appointed roadmaster of the Arlington district of the Oregon division of the Union Pacific, with headquarters at Pendleton, Ore., to succeed **B. F. Hamlin,** who has been granted a leave of absence.

J. C. Jacobs, an instrumentman on the Illinois Central at Carbondale, Ill., has been promoted to supervisor of track, with headquarters at Clinton, Ill., to succeed **S. C. Jump,** whose appointment as division engineer is noted elsewhere in these columns.

C. C. Pelley, bridge and building foreman on the Illinois Central at Chicago, has been promoted to supervisor of track at the same point, to succeed **R. H. Carter,** whose appointment as assistant general yardmaster is noted elsewhere in these columns.

A. E. Stewart, acting division engineer on the Canadian Pacific at Nelson, B.C., has returned to the position of roadmaster, with headquarters at Cranbrook, B.C., succeeding **B. Fredbeck,** acting roadmaster, who resumes the position of section foreman on the Vancouver division.

A. M. Harris, assistant supervisor on the Philadelphia division of the Pennsylvania, has been promoted to supervisor on the Buffalo division. **H. H. Vaughn,** assistant supervisor on the Buffalo division, has been transferred to the Philadelphia division, with headquarters at Harrisburg, Pa.

E. Iverson, assistant roadmaster on the Chicago, St. Paul, Minneapolis & Omaha at Emerson, Neb., has been appointed acting roadmaster with the same headquarters, to succeed **A. Daugherty. L. Hogan** has been appointed acting assistant roadmaster at Emerson, to replace Mr. Iverson.

R. F. Fox, track supervisor on the Denver & Rio Grande Western at Pueblo, Colo., has been appointed assistant roadmaster, with headquarters at Salida, Colo. **H. J. Willard,** instrumentman in the engineering department at Alamosa, Colo., has been appointed assistant roadmaster at Grand Junction, Colo.

R. E. McMahon, a section and extra gang foreman on the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Wyocena, Wis., has been promoted to roadmaster with headquarters at Wausau, Wis., to succeed **R. H. Cunningham,** who has retired. **J. H. Boland** has been appointed roadmaster with headquarters at Janesville, Wis., to succeed **A. C. Tubaugh,** who has also retired.

Marshall M. Killen, who has been appointed general foreman of bridges and buildings and water service of the Gulf, Colorado & Santa Fe, with headquarters at Galveston, Tex., as reported in the June issue, has been identified with this company for about 18 years. He was born on December 25, 1892, at Longstreet, La., and after a public school education he entered railway service with the G.C. & S.F. on November 12, 1919, as an extra gang timekeeper. From April, 1920, to June, 1922, Mr. Killen served as an extra gang foreman and roadmaster's clerk. At the end of this period he was appointed track inspector, which position he held until February, 1923, when he was promoted to roadmaster. He was holding this position at the time of his recent promotion to general foreman of bridges and buildings and water service. He has jurisdiction over the Gulf division.

Garrett Honey, whose appointment as roadmaster on the St. Louis-San Francisco, with headquarters at Cuba, Mo., was reported in the June issue, was born on November 3, 1896, at Stoutland, Mo. He entered railway service with the Frisco on August 1, 1913, as a laborer in a rail-laying gang. For about three years he worked in extra gangs and for another two years he was engaged as a regular section laborer. On April 15, 1918, Mr. Honey was promoted to section foreman and served in this capacity on various territories until July 1, 1925, when he was promoted to extra gang foreman. From 1928 to 1930, he served as assistant steel gang foreman, then being promoted to general yard foreman at Memphis, Tenn. On July 15, 1930, Mr. Honey was further promoted to roadmaster of the Twenty-Second track division of the Southern division, being transferred to the Twenty-First track division of the same division on September 15, 1936. He now becomes roadmaster of the Second track division of the Eastern division with headquarters at Cuba.

Claude L. Flinn, whose appointment as roadmaster on the Chicago Burlington & Quincy, with headquarters at Beardstown, Ill., was announced in the May issue, has been identified with this company for about 14 years. He was born on June 30, 1905, at Colmar, Ill., and after a public school education he entered railway service with the Burlington on March 30, 1923, as a section laborer. After serving in this capacity at Tennessee, Ill., and Macomb, Mr. Flinn was advanced to extra foreman on January 7, 1924, which position he held until April 13, 1925, when he was further promoted to section foreman, with headquarters at Colchester, Ill. During the following six years Mr. Flinn alternated between the position of section foreman at Colchester and that of extra gang foreman on surfacing and rail laying during the working season. On October 1, 1931, he was promoted to supervisor, which position he held until his recent promotion to roadmaster at Beardstown.

Thomas L. Jones, who has been appointed roadmaster on the Missouri Pacific, with headquarters at Coffeyville, Kan., as reported in the June issue, was born on September 11, 1902, at Taylor, Miss. Mr. Jones received his higher education at Mississippi State college, graduating in June, 1926, with a degree of bachelor of science in civil engineering. He entered railway service on September 7, 1926, with the Illinois Central, as a rodman at Hattiesburg, Miss. On April 15, 1928, Mr. Jones resigned to enter the service of the Missouri Pacific as a rodman at Monroe, La., being advanced to instrumentman at McGehee, Ark., on October 20, 1928. On April 16, 1929, he was transferred to the Central Kansas division at Osawatomie, Kan., where he remained until June 1, 1931, when he was made an extra gang foreman on the same division. On January 16, 1934, he was advanced to track supervisor on the Colorado division, with headquarters at Scott City, Kan., which position he was holding at the time of his recent appointment as roadmaster on the Central division at Coffeyville. Mr. Jones introduced the Bartlett method of string lining curves on the Missouri Pacific and is the author of a pamphlet on this method, which is used widely on his road.

Bridge and Building

Fred A. Armstrong, supervisor of bridges and buildings on the Southern Pacific, with headquarters at Bakersfield, Cal., has been transferred to Los Angeles, to succeed **Charles W. McCandless,** who has retired.

C. M. Dorsey, bridge and building foreman on the Alamosa division of the Denver & Rio Grande Western, has been promoted to master carpenter, with headquarters at Alamosa, Colo., to succeed **Herbert Taylor,** who has retired.

James J. Meacham, who has been appointed bridge and building supervisor on the Northern Pacific, with headquarters at Seattle, Wash., as reported in the June issue, has had a varied experience with a number of railroads. He was born on March 15, 1888, at Hillsboro, Ore., and first entered railway service in 1908 with the Southern Pacific, serving with this company until 1912. From that year until 1914, Mr. Meacham was engaged in the construction of snow sheds in the Cascade mountains for the Great Northern. From 1914 to 1918, he was in the employ of the Alaska Railroad, resigning at the end of this period to join the United States Army. After serving overseas with the Twenty-Second Engineers, Mr. Meacham returned from the war in 1919, to enter the service of the Northern Pacific, with which company he has served in various capacities.

Obituary

M. A. Sheehan, supervisor of track on the Illinois Central at Mattoon, Ill., died on June 12.

A. B. McVay, who retired on July 1, 1930, as supervisor of bridges and buildings of the Evansville division of the Louisville & Nashville, died on April 20 at St. Petersburg, Fla., following a brief illness. Mr. McVay was born on June 26, 1858, and entered the service of the Louisville & Nashville on August 6, 1875, as a carpenter. Three years later he was promoted to bridge and building foreman

and on March 4, 1879, he was made acting supervisor of bridges and buildings. He served as supervisor of bridges and buildings from August 1, 1899, until his retirement. For many years Mr. McVay was active in the affairs of the American Railway Bridge and Building Association and served as a member of the Executive committee of this organization from 1917 to 1921.

M. F. Clements, engineer of bridges of the Northern Pacific, with headquarters at St. Paul, Minn., died on June 8 following an eleven-months illness. Mr. Clements had been in the service of the

M. F. Clements

Northern Pacific for 30 years. He was born on March 13, 1875, at What Cheer, Iowa, and was educated at the University of Iowa, obtaining the degree of bachelor of science in civil engineering in 1899 and that of civil engineer in 1904. In 1899 he went with the United States government as a draftsman, leaving this connection in the following year to go with the Chicago, Rock Island & Pacific as an assistant engineer. After five years in this position Mr. Clements entered the service of the Clinton Bridge & Iron Works, Clinton, Iowa, as an engineer, with which company he remained for two years. In 1907 he joined the Northern Pacific as assistant engineer, holding this position until 1917, when he was advanced to engineer of bridges.

Electric Heating Units and Devices—A 60-page catalogue bearing this title has been published by the General Electric Company, Schenectady, N.Y., in which is described and illustrated the complete line of electrical heating devices manufactured by this company. This publication is designated as GED-650.

Coupled Cameron Pumps—The Cameron Pump division of the Ingersoll-Rand Company, New York, has issued a 16-page bulletin, No. 7066, covering its line of coupled, general service pumps of capacities from 150 to 5,000 gal. per min against heads from 20 to 250 ft. The bulletin not only discusses the characteristics of the different sizes of pumps available and includes many views of pump installations, but also describes and illustrates features of the pump design and construction.

Supply Trade News

General

The Syntron Company has moved its general offices and factory from Pittsburgh, Pa., to Homer City, Pa.

The American Steel & Wire Company, subsidiary of the United States Steel Corporation, officially opened its new modern continuous rod mills at Joliet, Ill., on June 23. These mills are part of a $5,000,000 improvement program begun in billet mills in Gary and South Chicago. The mills are the first rod mills to be equipped throughout with anti-friction bearings. The total annual capacity is 22,000 tons.

Personal

Robert W. Law, sales representative in the New York division of the **A. M. Byers Company,** Pittsburgh, Pa., has been appointed division manager in the Boston (Mass.) office, effective June 16, to succeed **J. J. Riley.**

L. T. McGuire, assistant sales manager of the **Byers Machinery Company,** Ravina, Ohio, has resigned to become divisional manager of the Large Excavator division of the **Harnischfeger Corporation,** Milwaukee, Wis.

C. C. Connolly, special engineer of the New York, Chicago & St. Louis, has resigned to become associated with the **American Fork & Hoe Company** as Eastern representative, with headquarters at New York, effective June 1.

Obituary

Arnold H. Told, general manager of the **Positive Rail Anchor Company,** Chicago, died in that city on June 25 of heart failure. He was born at Vevay, Ind., on November 11, 1883, and was educated at Denison university, Granville, Ohio. In 1906 he was employed as an assistant on the engineering corps of the Consolidated Mining Company, Spadra, Ark., and in the following year was a rodman for the St. Louis-San Francisco at Chaffee, Mo. In the same year, he worked as a concrete inspector for the Baltimore & Ohio at Indiana Harbor, Ind., and in 1908 was an instrumentman in the United States Reclamation Service at Browning, Mont. In 1909 he became an engineer for the Columbia Gas & Electric Company at Huntington, W. Va., and in the following year he entered the employ of the Chicago & North Western as an instrumentman at Winner, S. D. In the following year he resigned to become an instrumentman on the Canadian Pacific at North Transcona, Man., and in 1913 he was promoted to resident engineer at this point. In the following year he was promoted to assistant roadmaster at Souris, Man., resigning in the same year to become an inspector for the Positive Rail Anchor Company at Winnipeg, Man. Later he was transferred to Montreal, Que., and in 1917 was made an engineer and salesman at New York. In 1919 he was promoted to general manager at Marion, Ind., and in 1927 he was transferred to Chicago. Mr. Told took an active part in the Track Supply Association, of which organization he was president in 1926-27 and which he served as secretary-treasurer in 1927-28.

Trade Publications

American Gopher—This is the title of a 16-page booklet issued by the American Hoist & Derrick Company, St. Paul, Minn., in which are described, largely by illustrations, the various applications of American Gopher excavators.

Centrifugal Fire Pumps—The line of ball-bearing centrifugal fire pumps manufactured by Fairbanks, Morse & Company, Chicago, is described in a 6-page illustrated folder, known as Bulletin 5814F, which was recently issued by this company.

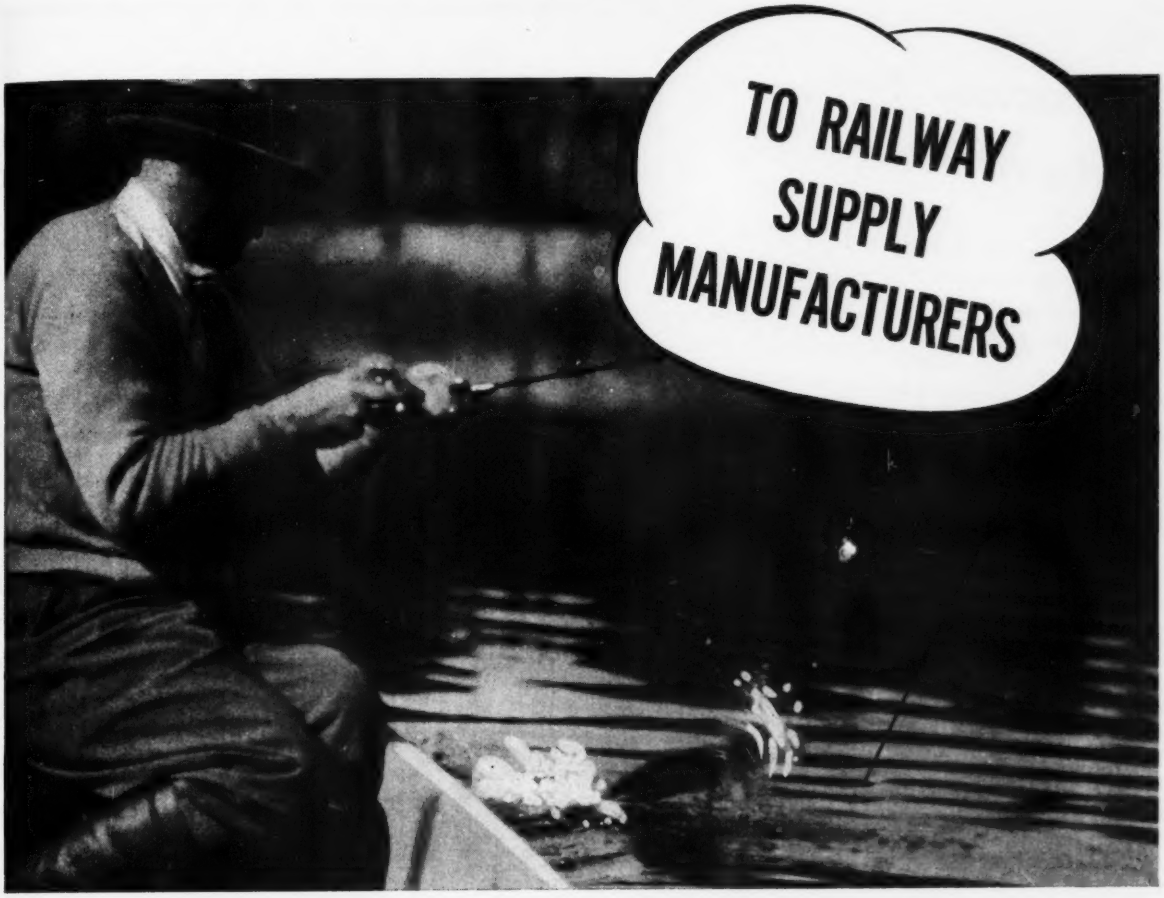
Centrifugal Pumps—Fairbanks, Morse & Company, Chicago, has issued a four-page folder which contains pertinent information concerning this company's line of Fig. 5870 ball-bearing centrifugal pumps.

Armco Multi Plate Bridges—The application of Armco Multi Plate pipe to the construction of small bridges is the subject of a 16-page brochure recently issued by the Armco Culvert Manufacturers Association, Middletown, Ohio. The booklet is profusely illustrated with photographs, some of which are printed in several colors.

Bonded Built-Up Roofs—This is the title of a 36-page illustrated booklet recently published by Johns-Manville, New York, in which 22 pages are devoted to specifications covering the installation of built-up roofs on various types of decks. A feature of the booklet is a tabulation giving the specifications in condensed form. Specifications are also given for the application of insulation, and several pages are devoted to a discussion of types of flashing.

Guide Book for Sheet Metal Workers—The United States Steel Corporation has issued a data book of 64 pages on the weights, dimensions and other pertinent facts concerning galvanized, black, terne and stainless steel sheets, together with useful information relating to the more common uses of these materials. Halftone illustrations depict operations in the fabrication or application of the sheets to various uses.

Concrete Joist Data—To facilitate the design of reinforced concrete floors for buildings, the Universal Atlas Cement Company, Chicago, has prepared a set of six cards, 4 in. by 15 in., that provide data and scales on both sides for the rapid and convenient design of solid concrete one-way slabs and precast joists, as well as cast-in-place joists with hollow tile fillers and also as constructed on metal forms.



LARGE FISH Are Not Caught with Bent Pins

Neither Are Railway Orders Landed with Amateur Methods

Railway buyers are wary buyers. They know what they want.

To land railway orders a manufacturer must know what bait (sales methods) to use. And he must know where and to whom the bait must be displayed.

Railway Engineering and Maintenance can help you locate these lurking orders, for it goes to and is read by maintenance officers everywhere—in the general offices, at division centers, at outlying supervisors' headquarters. It also reaches many of the more alert foremen.

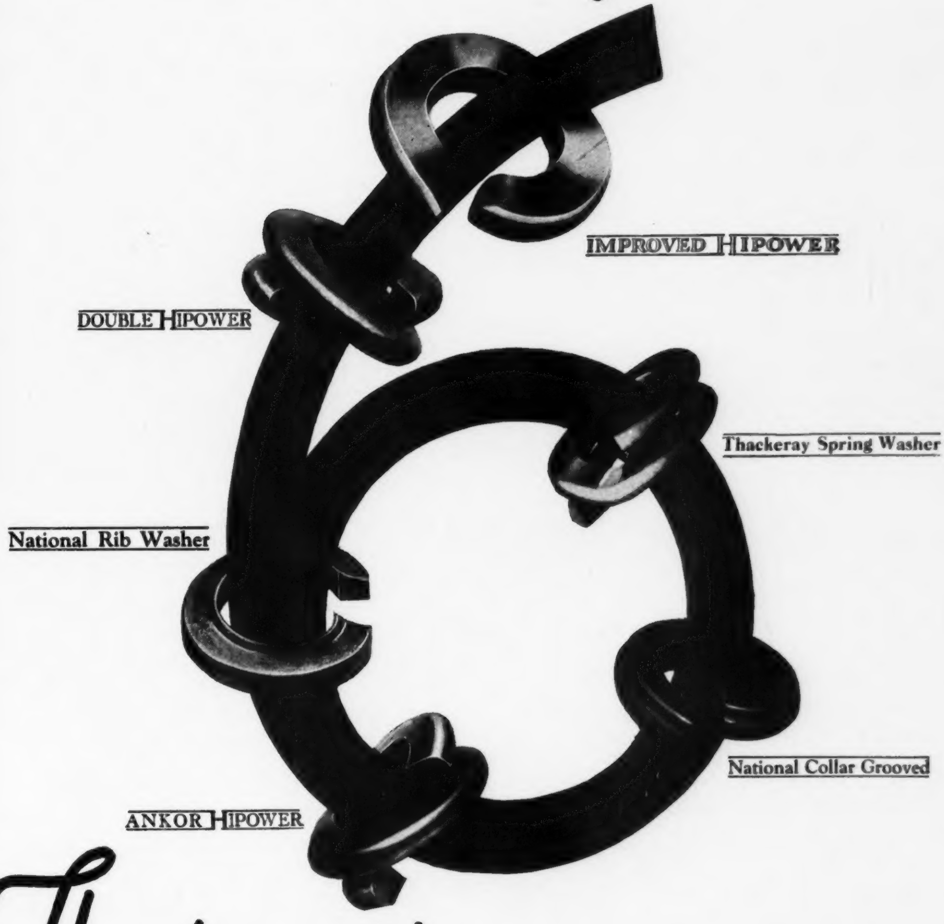
It can place your bait (your sales message) before these men, no matter how inaccessible they may be. It is as indispensable to railway sales as tackle is to the successful fisherman.

To insure the maximum number of "strikes" (orders), present the merits of your products to your potential customers month by month—and to your present customers as well—in the magazine which they read first of all.

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

ALPHABETICAL INDEX TO ADVERTISERS

The Big



That meet every Railway need!

THE NATIONAL LOCK WASHER COMPANY

NEWARK, NEW JERSEY

SPRING WASHERS • RETAINING RINGS • DROP FORGINGS • CAR WINDOW EQUIPMENT • RAILWAY AND BUS WINDOWS